RESEARCH ARTICLE

A questionnaire survey of the Brazilian dipterological research community

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ABSTRACT. In this study, we conducted a survey of researchers studying flies in Brazil, with the aim of acquiring up-to-date information about them, across multiple aspects, i.e., demographics, opinions, needs, and the main challenges they face. We developed an online questionnaire and collected the responses between September and November 2019; 126 responses were received. Most of them held a Ph.D. and identified themselves as males. Nearly all respondents worked exclusively in public institutions, and most were financially reliant on scholarships provided by public agencies. All of them studied at least one of the 81 dipteran families known to occur in Brazil, with most respondents working on families that included taxa of public health importance. Additionally, most work conducted by these researchers was rooted in systematics/taxonomy. A specific portion of the respondents (i.e., students) felt less integrated into the research community and found it challenging to publish high-impact research. However, some concerns were shared across all respondent subgroups, such as the need for increased funding and a more seamless integration within the research community. Academic professionals highlighted limited funding and inadequate infrastructure as barriers to research. Nevertheless, some subgroups expressed concerns about their career prospects. Although there may be limitations in the sampling process underpinning this study, our survey provides valuable insights into the demographic characteristics of Brazilian dipterist community, thus facilitating the development of policy strategies.

KEY WORDS. Brazil, careers, demography, Diptera, funding, outreach.

INTRODUCTION

Diptera, commonly known as "true flies," represents one of the most abundant, diverse, and widespread orders of insects. With approximately 160 recognized families, flies are found in all major biomes on Earth (Borkent and Brown 2015, Evenhuis and Pape 2021). Diptera are globally important across a wide array of spheres (e.g., agriculture, ecology, public and veterinary health, etc.). They also serve as vectors of plant pathogens and pests. These insects represent a diverse range of evolutionary trajectories, with many of them inhabiting both aquatic freshwater and terrestrial environments. Additionally, certain dipteran species are recognized as ecosystem engineers and keystone species (Foottit and Adler 2009).

Brazil is one of the most biodiverse regions in the world. This diversity is reflected in the large number of dipteran species hosted in this region (Rafael 2022), with at least 11,735 having been identified across 1,992 genera and 101 families (Rafael 2022). Consequently, it is crucial to understand the characteristics of the research community that is dedicated to studying these insects.

The history of dipterology and the biographies of dipterists have been documented in journal articles and books. In Brazil, only two surveys have been conducted on dipterists working within the country: the "Diretório dos

Dipteristas da América do Sul" (de Carvalho 1998-2009) and "Authors of Fly Names" (Evenhuis 2013). Some systematists and taxonomists who made significant contributions to the discovery and study of Brazilian dipterans and their corresponding neotropical habitats have been mentioned in broader publications focusing on the diversity of terrestrial invertebrates (Papavero 1971, 1973, de Carvalho et al. 2002, Brandão et al. 2006, Marques and Lamas 2006, de Carvalho 1998–2009, Silva et al. 2009). Additionally, Amorim et al. (2002) provided an overview of Neotropical dipterology in Brazil. The biographies and obituaries of Brazilian dipterists also constitute the body of work that has been published on these researchers (Papavero 2013, Klassa and Santos 2012, 2014, Fontanetto 2020).

The last comprehensive characterization of dipterist communities in Brazil was conducted over a decade ago. Marques and Lamas (2006) conducted a census of Ph.D.-educated zoological systematists working in Brazil. They also listed the most extensively researched taxonomic groups based on the number of individual researchers studying them. According to their findings, Diptera ranked third with 28 dipterists actively working in the country at that time.

The data used by Marques and Lamas (2006) were collected from Plataforma Lattes, an online curriculum vitae database maintained by the Brazilian National Science Agency (Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq, http://lattes.cnpq.br/). Subsequently, using the same database, Silva et al. (2009) identified 3,173 researchers interested in Diptera, not limited to systematists. Among these researchers, 1,651 held Ph.D. degrees. Additionally, most specialists identified in this study focused on the synanthropy of their organisms of interest, which often involves the transmission of pathogens to humans.

The findings of Marques and Lamas (2006) and Silva et al. (2009) cannot be directly compared because of differences underlying their inclusion and search criteria. For instance, Marques and Lamas (2006) focused exclusively on systematists, whereas Silva et al. (2009) included other specialists.

The website "Diretório dos Dipteristas da América do Sul" compiled by de Carvalho during the years of 1998–2009 is an important source of data regarding Brazilian dipterists and provides a list of 174 researchers. For example, de Carvalho et al. (2002) used the abovementioned directory (i.e., compiled until 1998) to identify 79 Brazilian researchers specializing in systematics and/or taxonomy. Additionally, in a study reviewing the diversity of terrestrial invertebrates, Brandão et al. (2006) listed the names of 25 taxonomists currently working on Diptera in Brazil.

Censuses and surveys serve as crucial research tools for characterizing a target population, either entirely or partially. Questionnaires are effective in providing valuable insights into the challenges faced by a specific group. Furthermore, surveys not only offer a temporal and historical context but also facilitate the evaluation and development of future projects and strategies to advance knowledge within a particular field (Evans and Mathur 2005, Wright 2005, Vasantha and Harainarayana 2016).

There is a thriving and productive community of dipterists in Brazil, as evidenced by the high number of corresponding authors (19.9%, 505/2538 articles) in Diptera studies published in Zootaxa over the past twenty years. This percentage surpasses the next most frequent national affiliation China, by more than 40% (Whitmore et al. 2021). However, despite this impressive presence, there is a lack of information and limited characterization of the dipterological research community in Brazil and its specific needs. This knowledge gap hinders further development in this scientific field and strategic planning for future growth.

To gain a comprehensive understanding of the dipterists community in Brazil, we administered a survey questionnaire. Our primary objectives were to quantitatively analyze the educational background of these dipterists and qualitatively explore their main challenges and needs in areas of education/training, career opportunities, funding, availability of infrastructure/resources, and efforts to promote public appreciation and understanding of science. Through this survey, we obtained a broad overview of the Brazilian dipterological research community and gained valuable insights into the characteristics and requirements of this group of researchers.

MATERIAL AND METHODS

Target population and inclusion criteria

In this study, we targeted professionals and students residing and working in Brazil, both within and outside academia, engaged in studies or work related to the order Diptera. We also included individuals who had previously been involved with Diptera but were inactive at the time of the survey for reasons such as retirement, unemployment, or departure from academia. To ensure that the analyses focused solely on dipterists, we utilized a single inclusion criterion: respondents must have completed at least one of their principal educational levels (i.e., undergraduate training or master's or Ph.D. degrees) with a focus on Diptera.

Questionnaire design and dissemination

An online questionnaire was created using Google Forms, a web-based tool provided by Google, LLC. Google Forms offers a freely accessible electronic platform for the development, distribution, response collection, collation, and analysis of user-developed surveys (Vasantha and Harainarayana 2016).

A link to the online questionnaire was sent to the 122 email addresses of individuals believed to be linked to Diptera-related work. This initial list of recipients was compiled from the aforementioned databases and personal contacts of the authors. However, the recipients were encouraged, via an accompanying email, to forward the link to anyone they knew who might be interested. Due to the anonymous nature of the survey, we could not determine the exact number of people who received the questionnaire link. The questionnaire was available for respondents to access and complete over thirteen weeks, from September 3 to November 28, 2019.

Structurally, the questionnaire was composed in Portuguese and consisted of a fixed common core, comprising three sections applicable to all respondents. Additionally, there was a fourth variable section with questions specific to the different subgroups of respondents. The common core included the following sections: 1) an initial mandatory section describing the purpose and nature of the survey, seeking the identification details of the researchers, and presenting the terms of free and informed consent that the respondents had to agree to participate anonymously in the study; 2) a section gathering personal data, including demographic information such as gender, age, nationality, educational background/level, and workplace; and 3) a section seeking the professional activities of the respondents, including questions about the taxonomic groups and disciplines/subject areas they studied, their career level/position, and whether they worked in the public or private sector.

The final question in the third core section (Question 6) was designed to divide the respondents into the following three subgroups: 1) professionals working in academia, encompassing postdoctoral researchers, visiting/adjunct professors, and tenured individuals; 2) professionals in non-academic sectors, such as those employed in private companies, government institutions, or teaching positions in basic or higher education institutions; and 3) undergraduate and graduate students. Participants of each subgroup then responded to their respective customized fourth and final "opinion" section, which included demographic and other career-related questions specifically tailored to their subgroup. These questions were intended to determine respondents' opinions on various topics related to research funding, career development and opportunities, and professional outlook.

The questions in the common core fell into three categories: i) short open-ended questions, also known as "short free-response" questions; ii) checkbox questions with suggested responses, where respondents could select multiple applicable answers or provide their own alternatives; and iii) multiple-choice questions with fixed, predefined responses, allowing respondents to select only one choice. In section four, both short- and long-open-ended questions were presented. Furthermore, respondents could indicate their level of agreement with certain statements on a scale of 1 to 5. The complete questionnaire, in its original Portuguese and translated English (for publication) versions, is presented in Appendix S1.

Data analysis and visualization

The resultant data were compiled using a response worksheet and Google Forms. Tables and figures were created to facilitate the understanding of the responses. For questions involving a linear scale, except for one, the scale ranged from 1 (completely disagree) to 5 (completely agree). To analyze the responses, ratings of 1 and 2 were grouped as "disagreed," ratings of 4 and 5 were grouped as "agreed," and a rating of 3 was considered "neutral." The only exception was Question 7 in the fourth section specifically directed at students, where the scale represented optimism (1 and 2 grouped as "optimistic") to pessimism (4 and 5 grouped as "pessimistic"), with 3 interpreted as "neutral." For three other related questions directed at different subgroups of respondents (academic and non-academic professionals and students), word clouds were generated to capture the responses. These word clouds were created using Jason Davies's online tool (https://www.jasondavies.com/wordcloud/). To ensure consistency, a standardized list of Portuguese words was translated into English. Words with similar meanings in respondents' answers were grouped and represented by a single word. For example, words like "financiamento," "financiar," "financeiro," and "financeiros" were standardized as "funding." Connectives and words without meaningful contexts were excluded. In cases where long, open-ended free responses were summarized in tables, the content was standardized into topics. Ambiguous or vague responses were excluded from the study.

To visualize the geographic distribution of dipterists across Brazil, we created a map using QGiS version 3.16

(QGIS Development Team 2020). The coordinates of the cities where the respondents lived were obtained using the web application GEOLocate (Rios 2019) and plotted on a map of Brazil with state boundaries. The map was edited using Adobe Illustrator. Each municipality with respondents was marked on the map and the size of the mark was adjusted to reflect the number of respondents from a particular location. As there were numerous municipalities with dipterists in the state of São Paulo, a separate inset map at a larger scale was created specifically for this region.

To visualize the distribution of dipterists based on phylogenetic relationships and research discipline/subject areas, we utilized R version 4.0.5 (R Core Team 2021) and the R packages ggtree (version 3.2.1) (Yu et al. 2017) and superheat version 0.1.0 (Barter 2017) to generate a heat map and associated bar charts. The phylogeny of the dipteran families used was derived from Wiegmann et al. (2011). We used the "tree.drawer" function of the R package phytools (Revell 2012) to extract the phylogeny, and any missing taxa were manually added based on their presumed or known phylogenetic affinities.

RESULTS AND DISCUSSION

A total of 132 participants completed the questionnaire. However, two individuals indicated a desire to withdraw from further participation, while four others stated that none of their main educational stages focused on Diptera. After excluding these six individuals, the final sample comprised 126 respondents.

Demographic data

Of the 126 responses that met the inclusion criteria, 53 (42%) and 73 (58%) were from female and male participants, respectively (Fig. 1). The age range of the respondents varied from "less than 20" to 74 years (Table 1). Most respondents

Table 1. Demographic characteristics of the respondents to the survey of dipterists in Brazil

Age group (years)	Female	Male	Total
Under 20	1	–	1
20 – 29	18	16	34
30–39	20	32	52
40–49	5	13	18
50–59	3	6	9
60–74	6	6	12
Overall	53	73	126

were 30–39 years old, accounting for 41% (n = 52) of all the respondents. If we consider the number of registered researchers (both active and retired) from the recently created "Rede de Dipteristas do Brasil" which is 158 (as of 10/03/2023; https://redediptera.wixsite.com/redediptera/diretório) the number of final 126 responses, we obtained and analyzed in this survey represent a substantial proportion (approximately 82%) of our intended target population. Although the proportion of dipterists in Brazil who responded to our survey was significant, we considered our study to be a survey rather than a census because it did not include the entire target population.

Most of dipterists working in Brazil were Brazilian nationals, accounting for 97% (n = 122) of the respondents. A substantial proportion of the respondents (42%, n = 53) held a postdoctoral position at some point in their professional trajectories (Table 2). In Brazil, various research activities conducted after the completion of a Ph.D. degree are referred to as "postdoctoral." These positions are typically short-term contracts, and postdocs are researchers who have recently obtained their Ph.D. degrees but have not been employed by universities as researchers or professors. The total number of respondents who had completed their Ph.D. was 79 (63%), which is considerably higher than the number of individuals (28; 5% of n = 542 taxonomists) reported by Marques and Lamas (2006) working with Diptera in Brazil.

Table 2. Educational level of the respondents to the survey of dipterists in Brazil.

Level of education	Female	Male	Total
Undergraduate (on-going)	2	2	4
Graduate	1	–	1
Master's degree (on-going)	4	5	9
Master's degree	4	3	7
Ph.D. (on-going)	12	14	26
Ph.D.	30	49	79
Overall	53	73	126

The respondents were based on 22 of the 27 Brazilian states, representing all five major geopolitical regions of the country (Figs 2–3, Table S1). Noteworthy is the high concentration of professionals and students in the southeastern region, where almost half of the respondents resided. This concentration can be attributed to the fact that a substantial number of respondents had received education in this region. Moreover, the presence of numerous institutions, particularly in the state of São Paulo, closely followed by Rio de Janeiro, contributed to a higher concentration of dipterists.

53 female
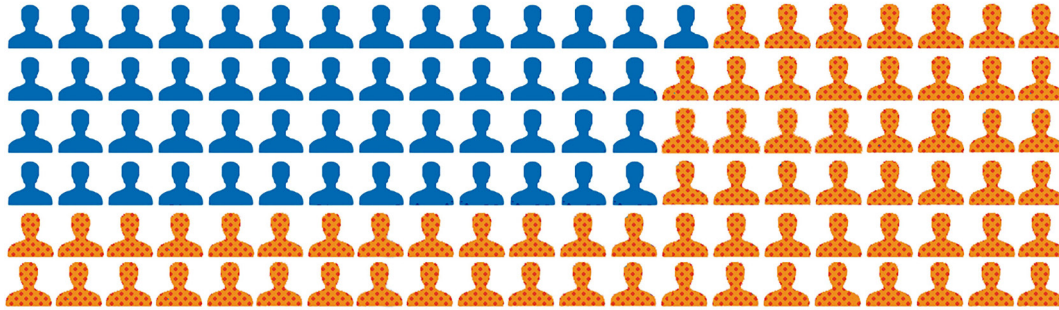
73 male

Figure 1. The number of respondents to the survey of dipterists in Brazil according to sex (n = 126). Females are represented in blue and males in orange.

As shown in Fig. 2, Table 3, and Table S1, most respondents obtained their highest level of education in southeastern Brazil. Specifically, the highest number of respondents received their degrees in the municipality of Rio de Janeiro (state of Rio de Janeiro), accounting 16% (n = 20) of the total, followed by São Paulo (13%, n = 16) and Ribeirão Preto (9%, n = 11) in the state of São Paulo. Other notable locations where respondents received their education include Manaus in the state of Amazonas in the North (13%, n = 17), Curitiba in the state of Paraná in the South (13%, n = 16), and Brasília (Federal District) in the Center-West (6%, n = 7). In northeastern Brazil, there was no prominent locality where the

Figure 2. Principal municipalities where respondents to the survey of dipterists in Brazil attained their highest level of education and currently work/study. For more details see Table S1.

Table 3. Geographical location and year of highest educational level attained of the respondents to the survey of dipterists in Brazil.

Country	State	1972–1988	1992–1994	1995–1999	2000–2004	2006–2009	2010–2013	2014–2017	2018–2022	Unknown*	Total
Brazil	Amapá	–	–	–	–	–	–	1	–	–	1
	Amazonas	–	–	1	2	–	4	5	4	1	17
	Distrito Federal	–	–	–	–	–	2	1	2	2	7
	Maranhão	–	–	–	–	–	–	1	–	–	1
	Minas Gerais	–	–	–	–	–	1	2	3	–	6
	Mato Grosso do Sul	–	–	–	–	–	–	–	2	–	2
	Pará	–	–	–	–	–	–	1	2	–	3
	Paraíba	–	–	–	–	–	1	1	–	–	2
	Pernambuco	–	–	–	–	1	–	–	–	–	1
	Paraná	3	–	2	–	–	3	5	5	–	18
	Rio de Janeiro	1	1	1	–	1	3	4	9	–	20
	Rondônia	–	–	–	–	–	–	1	2	–	3
	Rio Grande do Sul	–	–	–	–	2	–	–	–	–	2
	Santa Catarina	–	–	–	–	–	–	–	1	–	1
	São Paulo	–	2	4	3	2	8	9	7	1	36
USA	Washington, D.C.	–	–	–	1	–	–	–	–	–	1
	New York	–	–	1	–	–	–	–	–	–	1
Canada	Ontario	–	–	–	–	–	1	–	–	–	1
UK (Scotland)		–	–	–	–	1	–	–	–	–	1
Unknown		1	–	–	–	–	–	–	1	–	2
Overall		5	3	9	6	7	23	31	38	4	126

*Some respondents did not provide the year, and these were included in this column.

respondents received their highest level of education. The municipality of João Pessoa (state of Paraíba) was represented by two respondents, whereas the other six respondents from this region were from six isolated municipalities in five different states. The state that educated the highest number of dipterists was São Paulo (29%, n = 36), followed by Rio de Janeiro (16%, n = 20), Paraná (14%, n = 18), and Amazonas (13%, n = 17). Additionally, four respondents who worked in Brazil received their highest level of education outside the country, specifically in Europe or North America.

The regional ranking outlined above can be attributed to the presence of traditional graduate programs in entomology, each specializing in different groups of Diptera. In the southeast region, five institutions play a significant role in the education of dipterists: Museu Nacional/Universidade Federal do Rio de Janeiro (MN/UFRJ) and Fundação Oswaldo Cruz (FIOCRUZ) in the municipality of Rio de Janeiro, Universidade de São Paulo (USP) and Museu de Zoologia of USP (MZUSP) in the municipality of São Paulo, and Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, USP (FFCLRP-USP) in the municipality of Ribeirão Preto, São Paulo. In northern Brazil, the main center of education is the graduate program at the Instituto de Pesquisas da Amazônia (INPA) in Manaus, while in the southern region,

there is a graduate program at the Universidade Federal do Paraná (UFPR) in Curitiba.

Until 2004, the respondents obtained their highest degree exclusively in the states of Rio de Janeiro, São Paulo, Amazonas, or Paraná. However, starting in 2006 and especially from 2010, the hiring of more dipterists in permanent positions associated with graduate programs outside traditional centers led to the training of researchers in Diptera in other states. Notably, the Federal District (n = 7) and the state of Minas Gerais (n = 6) became involved in dipterist education. This expansion is a direct consequence of the Reestruturação e Expansão das Universidades Federais (REUNI) initiative implemented by the Ministério da Educação from 2007–2008. This program, in conjunction with other policies, fostered the establishment of new universities and campuses, particularly outside the state capital. As a result, existing institutions have expanded significantly, more than doubling the number of faculty members in federal universities (Diniz-Filho et al. 2016).

To clarify the data, the following categories of institutions are found in Brazil: Federal and State Universities, Private Universities, Federal and State research institutions (such as Embrapa and INPA), and the private sector. Federal and State Universities in Brazil are publicly funded by the
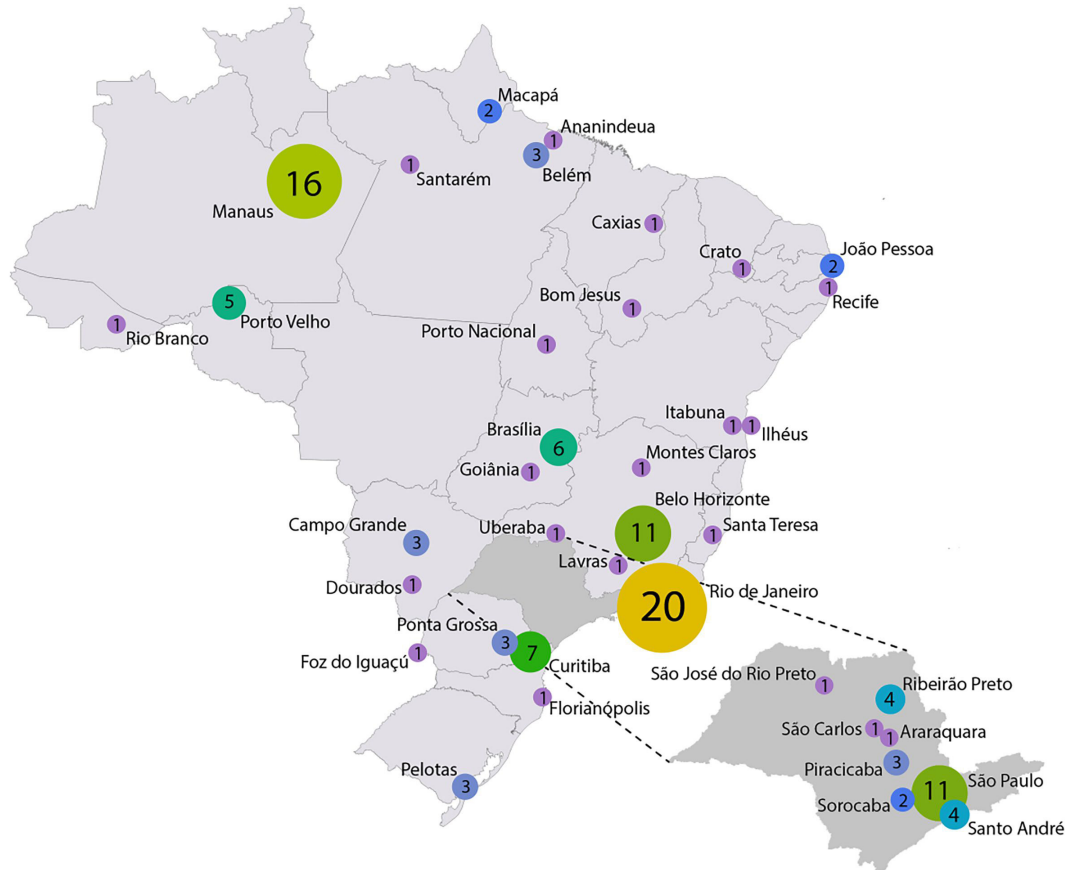
Figure 3. Geographic distribution of the respondents to the survey of dipterists in Brazil, according to their municipality of work. The circles are drawn with size proportional to the number of respondents. The state of São Paulo is represented separately due to the high density of municipalities with dipterists working within it.

federal and state governments, respectively, and play a significant role in higher education and research, offering a wide range of academic programs. In contrast, private Universities are privately owned institutions that operate independently and are funded through tuition fees and private investment. They provide educational opportunities like those offered by public universities. Federal and State research institutions, such as Embrapa (Brazilian Agricultural Research Corporation) and INPA (National Institute of Amazonian Research), are research centers and institutes funded by the government. They focus on specific areas of research, including graduate programs and contribute to a country's scientific and technological development. The private sector includes privately owned companies and organizations that operate independent of government funding. Private sector professionals may be involved in various fields, including research, consulting, or industry-specific roles.

In terms of employment, most respondents (60%) were professionals working in academia, including postdoctoral researchers (referred to as subgroup 1 in the Methods section) (n = 71; Fig. 4 and Table S2). Among these professionals, the majority identified as male (62%, n = 44) and 75% reported having a permanent position (n = 53). Approximately a quarter of the professionals had temporary short-term contracts (25%, n = 18), primarily held by postdoctoral researchers (n = 11). Among the professionals in permanent positions (n = 53), the majority (53%, n = 28) did not hold administrative positions. Of those in administrative roles, almost half were coordinators of graduate programs (48%; n = 12).

The second largest subgroup of respondents consisted of undergraduate and graduate students (referred to as subgroup 3 in the Methods) (36%, n = 45), with the majority being male (58%, n = 26). This subgroup was predominantly composed of Ph.D. candidates (58%, n = 26), followed by nine master's

45 students
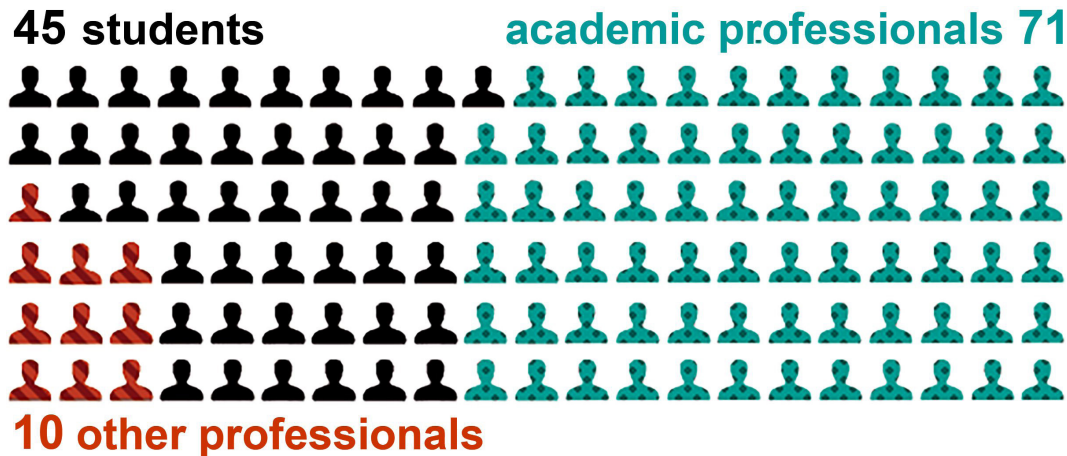
academic professionals 71

10 other professionals

Figure 4. Employment profiles of the respondents to the survey of dipterists in Brazil, according to their career level/stage, given in absolute numbers (n = 126). Professionals working in academia (subgroup 1) are represented in green; professionals in non-academic sectors (subgroup 2) in red; and under- and postgraduate students (subgroup 3) in black.

students (20%) and four undergraduate students (9%). Most students were enrolled in federal institutions (80%, n = 36), while seven (16%) attended state institutions. Most students relied on scholarships provided by government funding (87%, n = 39), while 9% (n = 4) primarily supported themselves through personal sources, such as their families. One respondent supported themselves through employment in a public office, and another respondent did not answer to this question.

The professionals from non-academic sectors (i.e., subgroup 2, as defined in the Methods) accounted for only 8% of all respondents (n = 10), and this was the only subgroup in which most people were female (60%, n = 6). Overall (i.e., considering all three subgroups combined), 92% of all the respondents worked exclusively in public institutions (n = 113), with the majority of these exclusively in federal institutions (n = 90, 73%). Considering only those that studied or worked in the academic sector, 97% were exclusively in public institutions (n = 108), 2% in both public and private institutions (n = 2), and 1% were independent researchers (n = 1). Only two people declared that they worked exclusively in the private sector (2%), while one person did not respond.

The respondents in this study had varying levels of experience in studying Diptera, ranging from one to 50 years. Among professionals working in academia, the majority had studied flies for 11 to 20 years, with the following distribution: six to 10 years (19%, n = 14), 11 to 15 years (25%, n = 18), and 16 to 20 years (18%, n = 13). As expected, students, who were in the early stages of their careers had relatively shorter periods of experience with Diptera: one to five years (41%, n = 18) and six to 10 years (45%, n = 20). Professionals outside

academia had varying responses but were less diverse than other professionals, with their experience ranging from three to 16 years of working on Diptera.

Overall, the respondents (n = 126) focused their work or study on 87 out of the 160 dipteran families currently recognized (Borkent and Brown 2015). This includes 80 of the 101 families found in Brazil according to Rafael's catalog (2022), as well as Zhangsolvidae, which is not listed in the catalog (Fig. 5 and Table S3). Most of the dipteran families studied were mentioned only once (40.2% of the families studied, n = 35) or twice (25.3%, n = 22). The most frequently cited families were Psychodidae (sand flies) (21.4% of the respondents, n = 27), Culicidae (mosquitoes) (8.7%, n = 11), Drosophilidae (fruit flies) (8.7%, n = 11), Simuliidae (black flies) (8.7%, n = 11), Calliphoridae (blow flies) (6.3%, n = 8), Muscidae (house flies) (5.6%, n = 7), and Tabanidae (horse flies) (5.6%, n = 7). Although a high proportion (80.2%) of the dipteran families found in Brazil are being studied, most researchers and students (47.6%, n = 60) focused their work on only seven families, which include fly species of medical and/or veterinary interest (i.e., Calliphoridae, Ceratopogonidae (biting midges), Culicidae, Muscidae, Psychodidae, and Tabanidae). This exceeds the number of dipterists expected based on the relative species richness of the dipteran families with medical and/or veterinary importance, which comprises only 22.2% (n = 2,605) of all 11,735 dipteran species in Brazil (Rafael 2022).

Among the families cited by the respondents who were not listed in Rafael's catalog (2022), three were fossils (i.e., Archizelmiridae, Valeseguyidae, and Zhangsolvidae), with only Zhangsolvidae found in Brazil, and four families did not occur
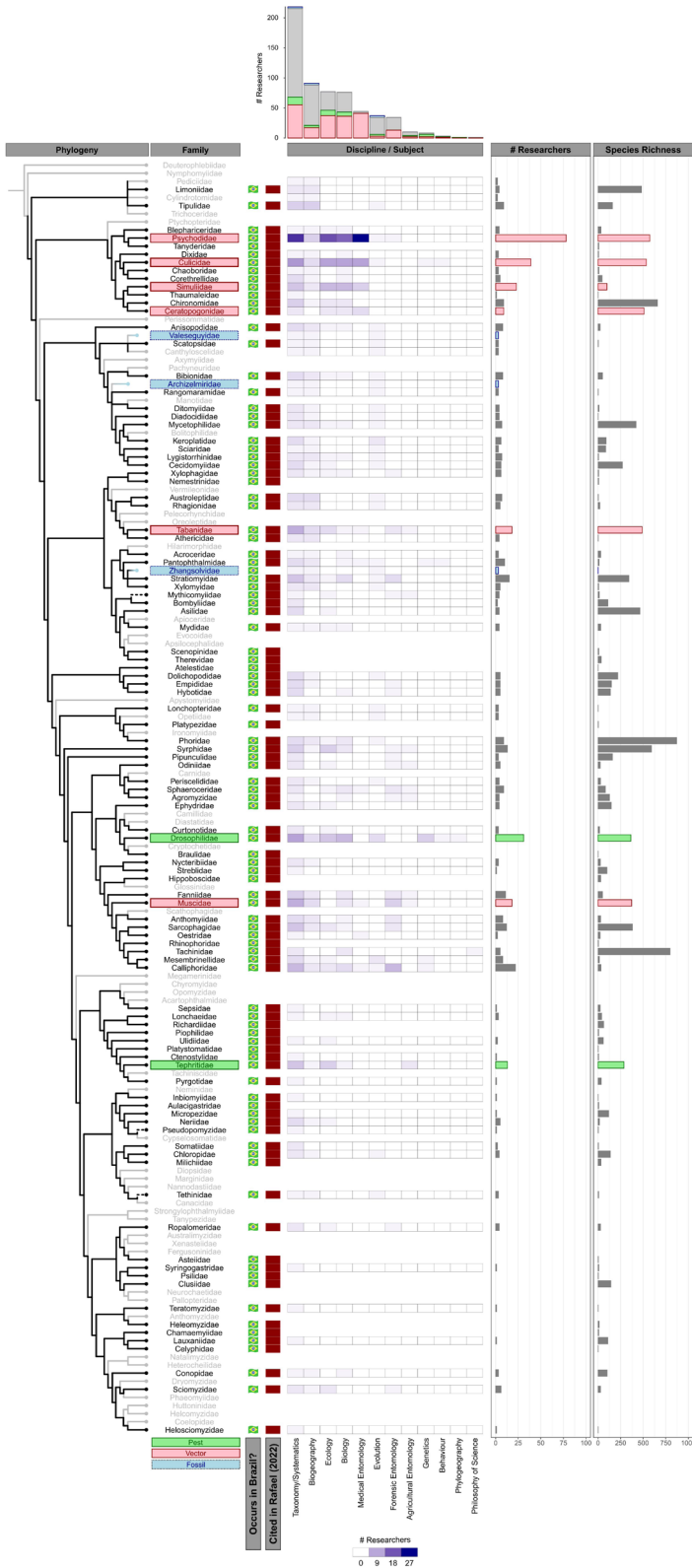
Figure 5. The phylogenetic and research discipline/ subject area distributions of the respondents to the survey of dipterists in Brazil. The absolute number of researchers working on each dipteran family cited in our survey by research discipline/subject area is represented by the intensity of the coloring within the heat map, where darker shading indicates a higher number of researchers. The total number of researchers for each research discipline/subject area (i.e., summed across dipteran families) is represented in the vertical bar chart immediately above the heat map, while the number of researchers for each dipteran family (i.e., summed across all research disciplines/subject areas) is represented in the horizontal bar chart immediately adjacent to the heat map. Note that the overall sum for the number of researchers studying different dipteran families (n = 244), as well as different research disciplines/subject areas (n = 600), is greater than the number of respondents to the survey (n = 126). This is because many respondents work on more than one dipteran family and/or research discipline/subject area (see Main Text). The horizontal bar chart on the right of the figure gives the species richness of each dipteran family in Brazil cited in the survey (data taken from Rafael 2022). The phylogenetic tree was extracted from Wiegmann et al. (2011), with missing taxa manually added (i.e., Archizelmiridae, Mythicomyiidae, Pseudopomyzidae, Tethinidae, Valeseguyidae, and Zhangsolvidae). The three fossil taxa are highlighted in blue, while the taxa of interest either because of their medical and/or veterinary importance, or agricultural and/or economic importance, are also indicated in red and green, respectively.

in Brazil (Canthyloscelidae, Cylindrotomidae, Pediciidae, and Opetiidae). Among the 21 families (76.2%, or 16 families) occurring in Brazil but not mentioned by any respondent, most have 13 or fewer species recorded within the country (i.e., Asteiidae, Atelestidae, Aulacigastridae, Brachystomatidae, Braulidae, Celyphidae, Chamaemyiidae, Heleomyzidae, Nemestrinidae, Piophilidae, Platypezidae, Platystomatidae, Psilidae, Rhinophoridae, Scenopinidae, and Tanypezidae) (Rafael 2022), while the remaining five families (23.8% of those not cited by respondents) have between 30 and 142 species recorded in Brazil (Clusiidae, Hippoboscidae, Milichiidae, Richardiidae, and Therevidae) (de Carvalho et al. 2012). One respondent mentioned working on the Acalyptratae, a broad suprafamilial taxonomic rank that includes some of the families mentioned above. Consequently, this response was not considered in the analysis.

Silva et al. (2009) reported 45 dipteran families in Brazil, whereas our survey highlighted 87 families. This represented a 93% increase in the number of studied taxa. However, the two families mentioned by Silva et al. (2009) (Richardiidae and Nemestrinidae) were not included in this survey. The fact that 21 families reported to occur in Brazil were not mentioned by our respondents can be explained by the possibility that (i) there are specialists currently working on these insect groups who did not respond to our questionnaire, or (ii) there are no specialists in these groups currently working in Brazil. The latter hypothesis suggests two possible scenarios: either researchers were trained but left academia due to a lack of opportunities for early career specialists to establish themselves or they ended their academic careers for other reasons. Alternatively, these dipteran families may be small in terms of species richness (fewer than 150 species recorded in Brazil) and do not require dedicated specialists, especially considering that most respondents worked in systematics and/or taxonomy. Families can support research based on the number of undescribed species they possess. However, specialists may choose to focus on a group that attracts more funding, such as a group that is important for public health.

Regarding research disciplines and subject areas (Fig. 5), the majority of the 126 respondents worked on systematics and/or taxonomy (83%, n = 104), followed by biology (39%, n = 49), ecology (38%, n = 48), medical entomology (27%, n = 34), and biogeography (25%, n = 32) were also frequently mentioned disciplines/subject areas.

Opinion section: closed-ended questions targeted to different subgroups

In the fourth and final sections of the questionnaire, dipterists were divided into three subgroups based on their career status: academic professionals, non-academic professionals, and students (subgroups 1, 2, and 3, respectively).

The questions aimed at the different subgroups mainly addressed their working conditions and the challenges associated with studying and researching Diptera (Table S4). Most respondents believed that funding for their research area(s) was insufficient, with 58% of academic professionals (n = 41) and 77% of students (n = 34) expressing this opinion. However, regarding laboratory infrastructure, both academic professionals (51%, n = 36) and students (64%, n = 29) reported working in places whose conditions were conducive to conducting research.

The availability of well-established biological or museum collections of Diptera in the institutions where the respondents worked shows a different picture. As we did not provide a specific definition for a "well-established biological collection" in the questionnaire, each respondent used their subjective criteria. The generally accepted criteria in systematics/taxonomy include institutional recognition, service provision (deposits, loans, etc.), curatorship/collection management practices, and infrastructure. While the responses from academic professionals were evenly distributed, with 37% (n = 26) indicating access to a good collection of flies and another stating they did not have such a collection, a small majority of students (53%, n = 24) reported working with well-established collections. The percentage of students reporting that they work with a well-established collection might differ from academic professionals, which might be attributed to students often choosing high-profile graduate programs that host well-established collections. When considering only the responses of professionals in permanent positions, older age groups (50–74 years old) tended to work in places with well-established collections, whereas younger age groups (30–39 years old) exhibited the opposite pattern.

It is worth noting that most students graduate from institutions with satisfactory infrastructure and "well-established biological collections". This may reflect the tendency of experienced professionals to attract more students than do those in the early stages of their careers. The observed trend of younger professionals working in places with less adequate infrastructure and resources was particularly evident in biology collections. The establishment of a well-established collection is a time-consuming and labor-intensive process that involves sample preparation, permanent mounting, storage, and curation. Therefore, younger researchers may not have had sufficient time to develop large collections at their workplaces. It is also important to emphasize that biological collections often rely on resources

obtained through research projects, which, as discussed later, are a major challenge faced by the dipterist community.

Most respondents agreed that publishing in high-impact journals in their subject areas was difficult; specifically, 57% (n = 40) and 87% (n = 39) of academic professionals and students held this opinion, respectively. The questionnaire defined "high impact" journals as those belonging to the A1 and A2 strata of the Qualis classification by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), a system specific to Brazil that considers journal impact factors and other parameters (https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/veiculoPublicacaoQualis/listaConsultaGeralPeriodicos.jsf).

Academic professionals and students have different perceptions regarding integration into the dipterological community. While 61% of academic professionals (n = 43) considered themselves integrated, only 21% of students (n = 9) felt the same way. Most students (61%, n = 27) provided a neutral response.

Regarding questions targeted only by academic professionals, most of them participated in graduate teaching programs that facilitated the development of their own research (61%, n = 43). Additionally, 35% (n = 25) agreed that there was a lack of students interested in their research area, whereas 32% (n = 23) disagreed with this statement. However, most academic professionals (79%, n = 56) expressed that if they could restart their careers, they would still choose to study Diptera compared to only 4% (n = 3) who would opt for a different professional path.

The section targeting students included questions about their career prospects and outlook after completing their training. Most students (82%, n = 37) intended to be employed as research professors in higher education institutions, whereas 51% (n = 23) aimed to work as researchers in research institutions. Other preferences included working as teachers in basic education institutions (20%, n = 9), researchers in private companies (20%, n = 9), and as technologists (18%, n = 8). Only 7% (n = 3) expressed a desire to be self-employed or entrepreneurs in a field related to their educational background. Most students (62%, n = 27) were pessimistic about their chances of success in achieving these objectives, while only 10% (n = 4) were optimistic.

Among those who left academia (subgroup 2), 60% (n = 6) out of 10 stated that they departed to pursue better opportunities in other professional fields, whereas 50% (n = 5) left because of a lack of job availability. Other reasons included a lack of scholarships for further education and training (n = 2) or a lack of affinity with the discipline/subject area (n = 1).

Opinion section: open-ended questions with long free-response answers targeted to different subgroups

Initiatives for promoting the education and/or career prospects of dipterists

The first question in the "Opinion" section, an open-ended, long, free-response question, was directed toward academic professionals and students. The question asked, 'What type of initiative could positively impact the education or job market of dipterists?'. The frequency of each topic mentioned by different individuals and their percentages relative to the total number of times each topic was cited are reported in the following text (see Table S4 for more detailed results). Among academic professionals, the most frequently mentioned topic was the need for increased funding (n = 21). Among academic professionals, the most frequently mentioned topic was the need for increased funding (n = 21). The second most-cited topic (n = 14) was the need to improve interactions among dipterists, followed by career development issues (n = 11), including limited job opportunities for dipterists and suggestions for improvement. The fourth type of initiative mentioned was integration with society at large (n = 10), which included government actors and other research sectors. Suggestions related to the education and training of undergraduate and graduate dipterists (n = 9) and the promotion of appreciation of dipterology (n = 4) were also mentioned. Table S4 provides a list of other cited initiatives and their respective citation frequencies.

Among the students, the two most cited topics were the need for increased funding (n = 11) and the integration of dipterology with society at large (n = 11). The second most-cited topic was low appreciation of the subject area (n = 6) and career development (n = 6), followed by the need for improved interaction among dipterists (n = 5) and suggestions related to the education and training of undergraduate and graduate dipterists (n = 4). Other types of initiatives are also mentioned and can be found in Table S4.

As previously mentioned, respondents highlighted the shortage of funding as a major obstacle to research advancement, education, training, and employment opportunities in the field of dipterology. However, this funding shortage is not exclusive to entomologists but is a common challenge faced by researchers in Brazil (and other countries as well). Nevertheless, the lack of appreciation for taxonomy and inadequate resources specific to this discipline were frequently mentioned by the respondents (given that most respondents worked in this subject area).

An example illustrating the need for additional funding for taxonomy is the establishment of the Programa de Capacitação em Taxonomia (PROTAX) by the Brazilian science funding agencies, CNPq/CAPES. In the most recent PROTAX funding call (#22/2020), six million Brazilian reais (approximately one million US dollars) were made available to fund 46 taxonomically associated projects. This funding call received an overwhelming response, with 362 project proposals submitted. In contrast, the "Programa de Pesquisa Ecológica de Longa Duração" (PELD; #21/2020), which supports long-term ecological surveys of various habitats, received 15 million reais (approximately 2.7 million US dollars) to finance 41 projects, with a total of 200 applications (data on these calls are available on the CNPq portal under "chamadas encerradas", http://portal.cnpq.br/web/guest/chamadas-publicas?p_p_id=resultadosportlet_WAR_resultadoscnpqportlet_INSTANCE_0ZaM&filtro=encerradas/).

Despite the example of the PROTAX, specific funding calls for the improvement of the infrastructure of biological collections, which are inherently connected to the work of taxonomists, are rare. The last funding call launched by CNPq for this specific purpose was made in 2013 (Chamada MCTI/CNPq/FNDCT – Ação Transversal #67/2013 – Coleções Biológicas). While various other sources of financing are available, Brazilian scientists primarily rely on two federal agencies, CAPES and CNPq, along with regional support from state-specific research foundations (e.g., FAPESP, FAPERJ, FAPEMIG, etc.; McManus and Neves 2021). The CNPq is the principal national funding agency for research projects, while CAPES primarily funds student scholarships. Thus, examples of funding calls from these two agencies hold significance in the national context.

The respondents also emphasized the need for better integration within the dipterist community in Brazil and the importance of dialogue with broader society. The lack of integration was attributed to factors such as students lacking financial resources to attend major scientific events such as the Simpósio de Diptera (The Diptera Symposium), held as part of the Congresso Brasileiro de Zoologia (Conference of Brazilian Zoology). Additionally, students also highlighted the infrequency of local and regional meetings, which would be more accessible to them than the abovementioned scientific events.

From the responses, it is evident that different respondents had varying perceptions of their level of integration within the dipterist community in Brazil. While one respondent described the community as extremely segregated, another asserted that Brazil has a robust and united dipterist society. Respondents highlighted the need for platforms and tools to facilitate communication among peers. This issue was discussed during the "VI Simpósio de Diptera" held as part of the "XXXII Congresso Brasileiro de Zoologia" in Foz do Iguaçu, Paraná, in 2018. The "Rede de Dipteristas do Brasil" (Network of Dipterists in Brazil) was established during the subsequent "VII Simpósio de Diptera" at the "XXXIII Congresso Brasileiro de Zoologia" in Águas de Lindóia, São Paulo, in March 2020 as a response to this demand (Haseyama et al. 2020). This network offers various forms of peer-to-peer communication, including email, messengers, and social network applications. Additionally, an informative newsletter called "O Balancim" (named after the Portuguese word for "halteres", which are the modified hindwings of flies) was created for the community, along with a website providing information on how dipterists affiliated with the network can be contacted (available at https://redediptera.wixsite.com/redediptera). These communication channels aim to address some of the challenges raised by the respondents, although the need for new forums that allow student participation in specialized scientific meetings remains.

Online events are no newer; the COVID-19 pandemic has led to the migration of many scientific events to online platforms (Milić et al. 2020). In many cases, these events were offered free of charge. Examples in the field of entomology in Brazil include the Curso de Verão em Entomologia at USP (organized by the graduate program in Entomology of FFCLRP-USP) and the Curso de Entomologia at UFPR (organized by the graduate program in Entomology of UFPR). While online events cannot fully replace in-person interactions, they offer certain advantages, including the inclusion of groups that find physical participation in meetings to be challenging and the elimination of travel and accommodation costs (e.g., Porpiglia et al. 2020, Raby and Madden 2021a, 2021b, Sarabipour et al. 2021).

In the answers to our questionnaire, respondents frequently cited public engagement and outreach programs as requiring improvement within the dipterological community. Problems with research funding can be related to a lack of public awareness and understanding of the importance of Diptera and their scientific investigation. This indicates minimal to zero political pressure to fund research on Diptera, especially regarding basic research and taxa that are not of obvious public health, agricultural, or economic benefits. Within the last five years, Brazil has experienced a significant decline in investment in science and technology. We also noticed that there is little engagement by non-scientific parts of society (e.g., mainstream media) in the

fight and debate for an adequate appreciation of Brazilian science. In day-to-day scientific practice, there is little spare time for academics and students to engage in outreach activities because of the demands of education, training, and research. Researchers also have their own language and converse among peers through their own specialized forms of communication, such as journals and scientific meetings, still following a model derived from and structured in the 19th century (Soler 2020). This isolates researchers and their discourses within a subculture distinct from that of the wider contemporary society.

Although there has been a rapid increase in the production and access to scientific information since World War II (Pickstone 2001), public engagement with science is still unequally distributed across different social groups. This inequality reflects wider cultural and social practices that perpetuate class and gender discrimination, racism, and other forms of group exclusion and oppression (Canfield et al. 2020). Regarding dipterology, few initiatives facilitate and promote dialogue between the wider society and the public. However, there are some examples of outreach conducted by dipterists primarily concentrated on the Internet. These initiatives, while primarily focusing on insects in general, also raise awareness of the importance of Diptera among a broader audience. Examples of such initiatives include the following.

– Inseto Pra Quê (What Are Insects For) (https://www.instagram.com/insetopraque/), created by Paula R. Riccardi of the Museum für Naturkunde Berlin;
– Mulheres na Entomologia (Women in Entomology) (https://www.instagram.com/mulheresnaentomologia/) (Toczek et al. 2020), created by one of us (RLF);
– LSDIP of the Laboratório de Systematics de Diptera of the Universidade Federal de Santa Catarina (LSDIP-UFSC) (https://www.instagram.com/lsdip_ufsc), coordinated by Luiz Carlos Pinho.

There is also the online profile Conhecendo Mosquitos (Knowing Mosquitoes) (https://www.instagram.com/conhecendoosmosquitos) particularly focusing on Diptera, by Flávia Virginio of the Instituto Butantan, who is also a co-author of the book O Fantástico Mundo dos Mosquitos (Lorenz et al. 2018). In addition, there are examples of direct interaction with the wider public. One example is the description of a new species of Chironomidae (non-biting midges): *Aedokritus adotivae* Pinho, 2018. The name of this species was chosen by children from the municipal school "Adotiva Liberato Valentim" in the state of Santa Catarina as a tribute to the school's name (Pinho 2018).

Gabriela Pirani (FFCLRP-USP) is the creator of the initiative Entomominas (a hybrid neologism combining the words "entomology" and "meninas," the Portuguese word for "girls") (https://www.instagram.com/entomominas). This project aims to encourage girls to be interested in and pursue science through education on biodiversity in collaboration with science teachers at schools of basic education (Pirani et al. 2020).

In addition to these initiatives, another noteworthy effort by researchers Neusa Hamada and Ruth Leila Ferreira Keppler at the INPA aims to popularize science in schools by promoting knowledge of the diversity and natural history of aquatic insects, including various species of Diptera. These researchers also published children's books (Belmont-Montefusco and Hamada 2011, Amora et al. 2014, Nascimento et al. 2014) and organized public exhibitions (http://www.fapeam.am.gov.br/insetos-aquaticos-despertam-o-interesse-de-criancas-no-bosque-da-ciencia/).

The major challenges for dipterists in Brazil

The second question in the "Opinion" section was an open-ended, long, free-response type question that asked all three subgroups of respondents about the major challenges for dipterists working in Brazil (Table S5). The wording of this question varied slightly depending on the subgroup of respondents: (i) academic professionals were asked about the challenges for the dipterist community in general and the specific challenges for early career professionals (those within 10 years of obtaining their Ph.D.); (ii) non-academic professionals were only asked about the challenges faced by the dipterist community in general; and (iii) students were asked about the challenges they faced as graduates or recent graduates.

The most cited challenge for the dipterist community, as reported by academic professionals (Fig. 6A), was the lack of funding and inadequate research infrastructure (n = 56). For early career academic professionals (Fig. 6B) and students (Fig. 6C), the most frequently mentioned challenges were related to career prospects and professional opportunities (early career professionals: n = 34; students: n = 21). Academic professionals (n = 10) and students (n = 10) ranked appreciation of science and the scientific profession as the third most cited topics. Other topics mentioned included research difficulties (e.g., administrative/bureaucratic paperwork, access to biological collections, and the need to balance research with other professional activities), integration within the dipterist community, education and training of human resources, and the current political situation in Brazil (including unfavorable public policies regarding scientific development and environmental preservation).
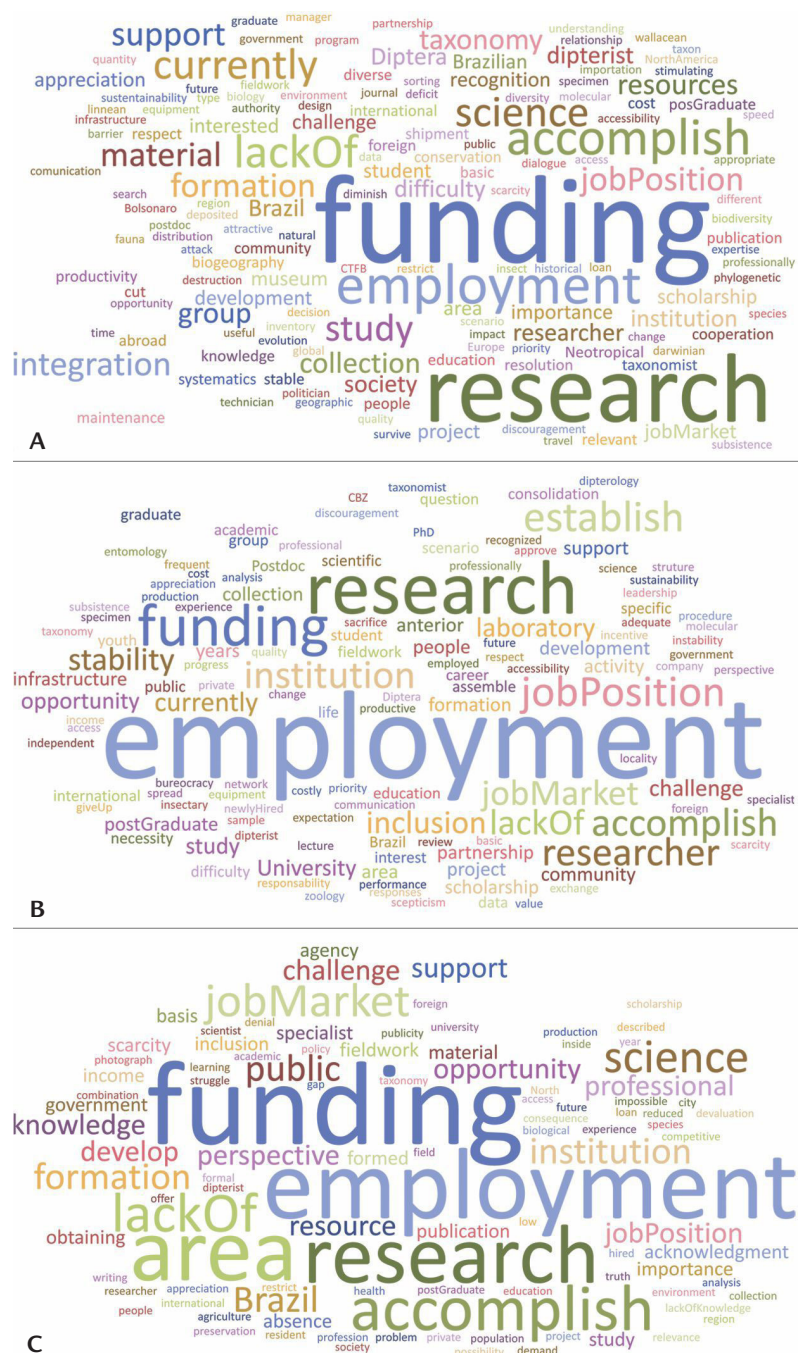
Figure 6. Word clouds generated from the following responses: A. Answers of academic professionals to the question "Describe what is, in your opinion, the major challenge for Brazilian dipterists"; B. Answers of academic professionals to the question "Describe what is, in your opinion, the major challenge for Brazilian early-career dipterists (within less than 10 years of obtaining their Ph.D.)"; C. Answers of students to the question "Describe what is, in your opinion, the major challenge for Brazilian dipterists graduating or having recently graduated". The words in the word clouds were standardized in Portuguese based on the criteria described in the Methods section, and then translated into English. Further details can be found in Table S5.

Responses were also obtained from dipterists who no longer work in academia (n = 7), and they raised the following topics: lack of funding, limited job opportunities in the labor market, difficulties in publishing research, the necessity of demonstrating and justifying the importance of basic science to the society and the general public, as well as reporting research results to them, and the "taxonomic impediment" (referring to the fact that the vast majority of Earth's biodiversity remains uncharacterized and undescribed, with insufficient resources available to catalog it before it becomes extinct due to human activity destroying natural habitats) (Engel et al. 2021). One respondent drew attention to a specific situation: "... young researchers are limited to centers/universities that possess reference [i.e., biological] collections, which enable them to continue developing their research. However, if they want real job opportunities, researchers must disperse themselves." The intention behind this response seems to be that early career researchers who aspire to secure permanent positions must often work in places with less favorable working conditions. Due to their lack of experience, it is challenging for them to obtain positions in more prestigious and well-equipped institutions.

While our survey does not allow us to draw definitive conclusions in this regard, it is likely that young tenured researchers tend to work in smaller institutions located in economically and socially less-developed areas, distant from more socioeconomically advanced regions, where larger and more established institutions are primarily located. Consequently, early career dipterists who establish their own research groups often face numerous challenges related to infrastructure and logistics. It is important to note that Brazil is a vast country with isolated urban areas scattered across the landscape. Moreover, early career scientists, particularly in smaller institutions, often bear significant administrative and undergraduate teaching responsibilities because of the shortage of relevant staff in their institutions (refer to Diniz-Filho et al. 2016 for a discussion on the impact of teaching load on the research productivity of scientists).

Miscellaneous comments left by the respondents regarding the survey

The third and last question of the open-ended long free-response type in the "Opinion" section asked all three subgroups of respondents to "Leave any comments that you consider relevant to the scope of this research" (Table S6). Among the respondents, 27 (38%) and 10 (22%) academic professionals and students left some of comment, respective-ly. The topic most cited by professionals was the relevance of our survey (n = 13), while among students, there was no dominant topic in their responses.

Regarding those who did not work in academia, four respondents provided comments. Two of them used the opportunity to make comments about the professional opportunities that they had embraced, while another lamented the lack of opportunities for postdoctoral scholarship, and how the small amount of available postdoc positions is taken by researchers with "unattainable curricula" i.e., with highly competitive curricula, while the fourth respondent pointed out that there is little opportunity to undertake basic science research.

The comments left by the respondents regarding the survey also raised issues similar to those already mentioned above in response to the other parts of the survey, such as the shortage of funding for research, infrastructure, and/or human resources; the lack of job opportunities for recent graduates; and the low appreciation of science and careers in academia in general. The lack of optimism among students regarding their career prospects and professional opportunities was particularly noticeable in both the miscellaneous comments and their responses throughout the survey. This opinion is probably a reflection of the perception of the diminishing number of the job positions in the public sector within Brazil, as the economic sector that absorbs most dipterists is the public sector, where 99% of the respondents either work or study in academia. After an increase of 27% in the number of the active civil servants in the executive branch of the Brazilian government between 2003–2015 (Magni 2016), the number has been falling year by year since 2017 (Painel Estatístico de Pessoal, updated on 12/02/2021, https://www.painel.pep.planejamento.gov.br/QvAJAXZfc/opendoc.htm?document=painelpep.qvw&lang=en-US&host=Local&anonymous=true). Further-more, the funds allocated to student scholarships have also suffered cuts (Angelo 2019), and their values have not been adjusted between 2013 and 2023 (i.e., in real terms, their value has declined over time due to increasing inflation in Brazil associated with the national economic crisis and recession).

FINAL REMARKS

Interestingly, most respondents were professionals in the academic sector, and most students who completed the questionnaire were representative of advanced educational levels (i.e., Ph.D.). Based on our survey, it is not possible to determine whether (i) there has been a reduction in the

number of dipterists starting their education and training, (ii) the questionnaire was not seen by those at the lower end of academic education and training (i.e., undergraduates and master's students), or (iii) there was less interest among the undergraduate or master students in responding to the questionnaire. The study provides an up-to-date and seemingly comprehensive overview of the community of dipterists currently working and/or studying in Brazil, although we cannot be certain of the completeness of our target population sampling. Nevertheless, we evaluated the demographic characteristics and range of taxonomic groups studied to gain insight into the needs and challenges of those who study Diptera. In addition, our results highlight the importance of government-funded research and/or teaching institutions for (i) the generation of knowledge on dipteran taxa found in Brazil and (ii) the education and training of human resources specializing in this group of insects. Most academic respondents (both professionals and students) were affiliated with institutions associated with public organizations (whether federal or state). In addition, the importance of scholarships for continuing the education and training of new dipterists remains clear, especially because most students support themselves through scholarships provided by either public bodies or foundations.

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Author Contributions

KLFH: Project administration, Conceptualization, Data curation, Formal Analysis, Writing – original draft, Writing – review & editing. PHFS and FDK: Conceptualization, Data curation, Formal Analysis, Writing – original draft, Writing – review & editing. RLF: Conceptualization, Writing – original draft, Writing – review & editing.

Competing Interests

The authors have declared that no competing interests exist.

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SUPPLEMENTARY MATERIAL

Supplementary material 1

Appendix S1. The questionnaire that was sent to the researchers.

Authors: KLF Haseyama, PHF Shimabukuro, FD Kirst, RL Falaschi.

Data type: Research form.

Link: https://doi.org/10.1590/S1984-4689.v41.e23012

Supplementary material 2

Table S1. The number of dipterists currently working and/or studying in Brazil by geographical location, and where their highest academic qualification (i.e., graduate, master's, or Ph.D. degree) was obtained.

Authors: KLF Haseyama, PHF Shimabukuro, FD Kirst, RL Falaschi.

Data type: Raw data collected.

Link: https://doi.org/10.1590/S1984-4689.v41.e23012

Supplementary material 3

Table S2. Number of dipterists currently working in different professional sectors.

Authors: KLF Haseyama, PHF Shimabukuro, FD Kirst, RL Falaschi.

Data type: Raw data collected.

Link: https://doi.org/10.1590/S1984-4689.v41.e23012

Supplementary material 4

Table S3. Comparison of the number of researchers for each family of Diptera cited in Silva et al. (2009) with the families cited by respondents to our questionnaire. The numbers of researchers given in the table are presented for all disciplines/subject areas combined, and only for those researchers working in systematics and/or taxonomy (in brackets).

Authors: KLF Haseyama, PHF Shimabukuro, FD Kirst, RL Falaschi.

Data type: Comparative data.

Link: https://doi.org/10.1590/S1984-4689.v41.e23012

Supplementary material 5

Table S4. Summary of the long answers to the question "What type of initiative could positively impact the education or the job market of dipterists?". The examples given below are based on the answers of the respondents but are not necessarily literal translations of their answers. The subgroups – either the academic professionals or students – indicate which group of individuals cited the topic, and the number of individuals and percentage within their subgroups. Since each respondent could list more than one topic, the percentage corresponds to the number of times a topic was mentioned relative to the total number of different topics cited within a particular subgroup (and not to the number of respondents). See Methods for details.

Authors: KLF Haseyama, PHF Shimabukuro, FD Kirst, RL Falaschi.

Data type: Raw data collected.

Link: https://doi.org/10.1590/S1984-4689.v41.e23012

Supplementary material 6

Table S5. Summary of the long answers to the questions "Describe what is, in your opinion, the major challenge for Brazilian dipterists graduating or having recently graduated?", directed to the student subgroup, "Describe what is, in your opinion, the major challenge for Brazilian dipterists?" and "For the young dipterists (within 10 or less years of the doctorate): what are the specific challenges for this group of researchers?", directed to subgroups of established and young academic professionals, respectively. The examples given are answers from the respondents but are not necessarily literal translations of their answers. The subgroups – either the academic professionals or students – indicate which group of individuals cited the topic, and the number of individuals and percentage within their subgroups. Since each respondent could list more than one topic, the percentage corresponds to the number of times a topic was mentioned relative to the total of different topics within a particular subgroup (and not to the number of respondents). See Methods for details.

Authors: KLF Haseyama, PHF Shimabukuro, FD Kirst, RL Falaschi.

Data type: Raw data collected.

Link: https://doi.org/10.1590/S1984-4689.v41.e23012

Supplementary material 7

Table S6. Summary of the long answers to the question "Leave any comments that you consider relevant to the scope of this research." The examples given are answers from the respondents but are not necessarily literal translations of the answers. The subgroups – either the academic professionals or students – indicate which group of individuals cited the topic, and the number of individuals and percentage within their subgroups. Since each respondent could list more than one topic, the per-

centage corresponds to the number of times a topic was mentioned relative to the total of topics within a particular subgroup (and not to the number of respondents). See Methods for details.

Authors: KLF Haseyama, PHF Shimabukuro, FD Kirst, RL Falaschi.
Data type: Raw data collected.
Link: https://doi.org/10.1590/S1984-4689.v41.e23012