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Article

A LOOK INTO THE GENDER DEMOGRAPHICS OF BRAZILIAN PALEONTOLOGY

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ABSTRACT – In 2020, a group of Brazilian female paleontologists from various universities and public institutions conducted the study "Brazilian Paleontology Gender Profile," whose main objective was to assess the current demographic diversity of Brazilian paleontologists and how the role of women has evolved throughout the history of the Brazilian Society of Paleontology. Initially, the project aimed to determine the number of professionals working in Paleontology and their demographic distribution in the country. However, our research expanded, encompassing race, Indigenous representation, LGBTQIAP+ data, parenthood, harassment, and gender violence. The present work presents the first installment of three sets of unpublished data, shedding light on gender issues and how to combat gender discrimination through the proposal of affirmative action policies that could be taken within the Brazilian Society of Paleontology and other scientific associations in South America.

Keywords: gender profile, women in science, gender biases.

INTRODUCTION

A brief consideration of where Brazilian researchers work

In Brazil, public institutions are the main contributors to Science and Technology (Escobar, 2020). According to the Web of Science database, compiled by Clarivate Analytics (2019), in 2019, 90% of scientific production in Brazil was conducted in Public Higher Education institutions (PHE). The data also reveals that out of the 50 institutions that published the most scientific works in the previous five years, 44 were public universities and five were federal government-affiliated research institutes. Although PHE professors must prioritize teaching, it is evident that they actively engage in research, besides extension and administrative activities.

The 2022 Brazilian Census of Higher Education indicates there are nearly 317,000 professors in public and private universities, with slightly over 149,000 being women (47.26%) (INEP, 2023). This represents a slight increase in the proportion of women compared to 2001, when they made up about 42% of the professors (INEP, 2002). However, the proportion of women professors in higher education has always been below 50%. The available data also highlight the ongoing gender disparity within Brazilian universities, indicating that these institutions are male-dominated and predominantly white (about 60%), particularly when considering positions of power and career advancement (INEP, 2023). Although there is salary equality between men and women at the same levels in Brazilian public institutions, the representation of women in decision-making positions is lower, resulting in lower average salaries for women professors and researchers (IBGE, 2024).

Studies demonstrate that gender disparities in Brazilian PHE persist at various stages of the teaching career, particularly among those who are still developing or in the early stages of

development. Data from the University of São Paulo (USP), for example, illustrates that much work still needs to be done to achieve gender equality within Brazilian academia and universities (Hsiou & Schultz, 2021). As of March 2019, USP had 5,844 professors, with 2,210 women representing 37.81% of the faculty (Adusp, 2019). When considering the number of professors at the initial level of their careers (Doctor Professor) at USP, about 43% were women, and this percentage decreased at higher career levels: 36% among Associate Professors and 28% among Full Professors (Adusp, 2019). These numbers reveal not only the lack of gender parity in all career levels but also that the higher the position, the lower the representation of women (Adusp, 2019).

The factors that explain these statistics are well-known and include the "*Glass Ceiling*", the "*Matilda Effect*", the "*Scissors Effect*", the "*Leaky Pipeline*", gender discrimination, lack of maternity support, and institutional racism, among others (Schiebinger, 2001). The expression "*Glass Ceiling*" describes how artificial barriers block minorities and women from advancing to the top (Tang, 1997; Vila-Concejo *et al*., 2018). The "*Matilda Effect*" occurs when women scientists are ignored and denied credit for their work and discoveries (Rossiter, 1993). The "*Scissors Effect*" is the manifestation of the disparity as a "scissor-shaped curve" when the proportion of female and male scientists is plotted at each of the key career transitions (Joyce *et al*., 2024). The "*Leaky Pipeline*" argues that the proportion of women in academia progressively decreases with advancing career stages (Piccoli & Guidobaldi, 2021). When viewed collectively, these obstacles reveal a reality in which, despite women's involvement in research and the development of science, they do not seem to attain significant levels of power in their careers or receive recognition proportional to their scientific qualifications and contributions.

Why discuss gender bias in Brazilian Paleontology?

In 2018, after learning of several reports of sexual harassment and violence against women students, a group of women paleontologists initiated a support network during the first-round table on Women in Paleontology at the XXV Brazilian Congress of Paleontology (2017) in Ribeirão Preto, São Paulo state. The main focus of this network was to provide support and assistance to the victims, particularly graduate students who had experienced abuse by a paleontology professor from the Federal University of Rio de Janeiro State (UNIRIO). To protect the identity of the victims, without disclosing the aggressor's identity, the Brazilian Paleontology Society (SBP) endorsed a manifesto against any form of violence and harassment against women within the SBP during the same congress, showing solidarity with the victims. Regrettably, many young women researchers abandoned their careers during this painful process.

Two years later, at the XXVI Brazilian Congress of Paleontology in Uberlândia (2019), Minas Gerais state, a second-round table on Women in Paleontology addressed the impacts of parenthood and sexual harassment on young researchers. After the round table, a call was made to form a women's group in paleontology. At that time, sixteen women paleontologists from twelve public universities in Brazil collaborated to construct the "Brazilian Paleontology Gender Profile" project. Its primary objective was to assess the current demographic diversity of Brazilian paleontologists and examine how the participation of women had evolved over the history of the Brazilian Society of Paleontology. Initially, the project aimed to determine the number of professionals working in paleontology in the country and their demographic data. However, the research was expanded to encompass broader topics, including a survey on race, Indigenous issues, LGBTQIA+ data, parenthood, harassment, and gender discrimination. Here, we present the first part of three sets of unpublished data to shed light on these issues, aiming to combat gender discrimination and oppression by strengthening affirmative action policies within the Brazilian Society of Paleontology and other scientific associations in South America.

METHODS

This study was submitted to the "Platform Brazil," a national database of human research records managed by the National Council of Ethics in Research, under the project "Brazilian Paleontology Gender Profile" (CAAE: 37147620.4.0000.5407), coordinated by ASH, in November 2020. The primary aims of this research are to examine the gender profile within Brazilian Paleontology, assessing its current diversity and how this profile has evolved over the history of the Brazilian Society of Paleontology (SBP). The project draws on two sources of data.

To gather primary data on the gender profile, an online questionnaire comprising both closed and open-ended questions was conducted between March and May 2021 to obtain quantitative data. The questionnaire was divided into nine sections containing a total of 54 questions: 1. Free and Informed Consent Term (TCLE), which explains the purpose of the survey and obtains consent from participants; 2. Social profile; 3. Representation of black paleontologists; 4. Representation of Indigenous paleontologists; 5. Academic profile; 6. Parenthood and Academia; 7. Participation in field trips; 8. Involvement in scientific consultancies; and 9. Experience of discrimination and harassment. All respondents were anonymous. For this phase, the Brazilian Society of Paleontology distributed the link to the online survey via email and its social media platforms. Our response options to questions on sexuality, race, and ethnicity were based on the self-identification criteria from the Brazilian Institute of Geography and Statistics (IBGE, 2003). A copy of the questionnaire is available at https://doi.org/10.6084/m9.figshare.29821559.v1.

The secondary data analysis relied on publicly available sources and aimed to assess gender representation and participation in congresses and events organized by the SBP, as well as publications in the *Revista Brasileira de Paleontologia* and the composition of the SBP Board. Data from the Lattes Curriculum of Brazilian the SBP members was also examined.

As mentioned, this work only presents the quantitative results concerning the demographic profile and social and academic characteristics of Brazilian paleontologists. Other research questions and secondary objectives will be addressed in future works to shed light on their academic backgrounds, professional engagement, scientific output, and leadership roles, providing an additional overview of gender dynamics within the SBP. Furthermore, data concerning discrimination, racism, and various forms of harassment (moral/sexual) will be published to explore potential links between representation and the impact of structural gender-related issues in Brazilian Paleontology.

RESULTS

The Brazilian Paleontology general data

To commemorate the 50th anniversary of the SBP in 2009, the book "50 Years of the Brazilian Society of Paleontology, a tribute to its Founders" was published, documenting the establishment of the SBP between the 1940s and 1960s (Kotzian & Ribeiro, 2009). According to the records, approximately 42 paleontologists were working in Brazilian Paleontology by the end of the 1950s. The SBP was officially founded on March 7, 1958, a date now celebrated as the Day of the Paleontologist in Brazil. The founding act of the SBP established its first board and approved the initial bylaws. Four of the 16 founding members were women, including Diana Mussa, Lélia Duarte, Maria Eugênia Marchesini Santos, and Maria Martha Barbosa. However, despite their involvement, all directors elected to the initial board were men. The book, which features a rich photographic record and significant historical insights about these pioneers, provides perspectives on how women perceived gender issues in Brazilian Paleontology during that era.

Maria Eugênia de Carvalho Marchesini Santos (UFRJ), one of the founding members, noted that pursuing a career in Paleontology as a woman required securing a supervisor with a strong *curriculum vitae* at a public research institution. Additionally, there was a necessity to convince others that fieldwork was equally feasible for both men and women (Kotzian & Ribeiro, 2009). Similar challenges persist in various fields of geosciences that are historically associated with STEM (science, technology, engineering, and mathematics).

Another noteworthy aspect is the representation of women in SBP leadership over the past 65 years (data until 2023). Only two of the 30 SBP boards have had female presidents, and women usually held vice-presidency positions. There is a persistent gender bias in the SBP boards since its establishment (Figure 1). This bias

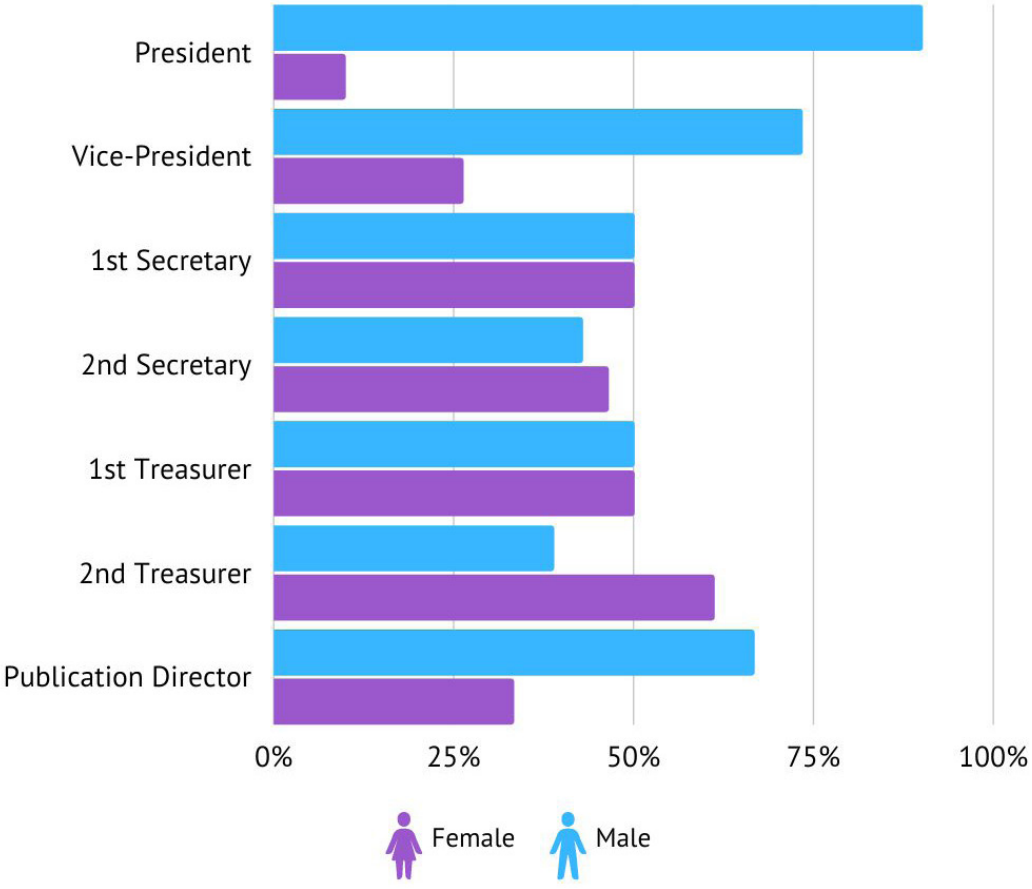

Figure 1. Gender distribution of presidents, vice-presidents, 1st secretaries, 2nd secretaries, 1st treasurers, 2nd treasurers, and publication directors of the Brazilian Society of Paleontology over the 65 years of its history (1968 to 2023).

is evident in both presidencies (90% of presidents were male) and vice presidencies (73.33% of vice presidents were male), while women have historically held positions as secretaries and treasurers. The secretary position is likely associated with traditional gender roles, where women have historically been involved in social reproduction within the caregiving framework (Vogel, 2013).

As of July 2020, the demographic database of the SBP included 713 members, with 321 of them being women, accounting for 45% of the membership. However, despite their significant presence within the SBP, women's representation in the national Paleontology community appears less prominent, particularly in leadership positions within the SBP board.

The online survey applied obtained responses from a total of 427 researchers. The first question addressed SBP membership, revealing that 45.7% identified as SBP members and 54.3% were non-members. Among SBP members, 48.2% were female researchers and 51.8% were male researchers (Figure 2). Regarding sexual orientation, cisgender female researchers comprised 47.8% of the respondents, cisgender male researchers 49.4%, transgender female researchers 0.5%, transgender male researchers 0.2%, agender individuals 0.2%, and non-binary individuals 1.9%.

Our research also investigated the gender of the authors who published in the *Revista Brasileira de Paleontologia* (RBP), the official journal of the SBP, over the last five years. For comparison purposes, the *Ameghiniana* (AMG), a journal of the Argentinian Paleontological Association, was used as a reference for South American Paleontology. Between 2017 and 2022, the RBP published 21 issues, totaling 151 papers. Women were the leading researchers (first author) in 42% of these papers, while men were in 58%. Men represent 63% of the co-authors, and women only 37%. This pattern is slightly better than the same period in AMG, where 35% of first authors were women and 65% were men. As co-authors, women comprised 34% of AMG's population and men 66%. The combined analysis of author/co-author data between the two journals shows that female participation has been around 34% over this six-year period (Figure 3).

According to Warnock *et al*. (2020), who analyzed publications in *Palaeontology* (the official journal of the UK-based Palaeontological Association), the percentage of female first authors has increased over time; however, it has never reached 20% of total authorship. The relatively higher representation of women in publications in the RBP can be attributed to the journal's status as a newer magazine with a lower Impact Factor. Several studies have indicated that gender bias can negatively affect peer review processes (Astegiano *et al*., 2019; Salerno *et al*., 2020; Warnock *et al*., 2020; Valenzuela-Toro & Viglino, 2021; Viglino *et al*., 2023), making it more challenging for women to publish in established paleontological journals.

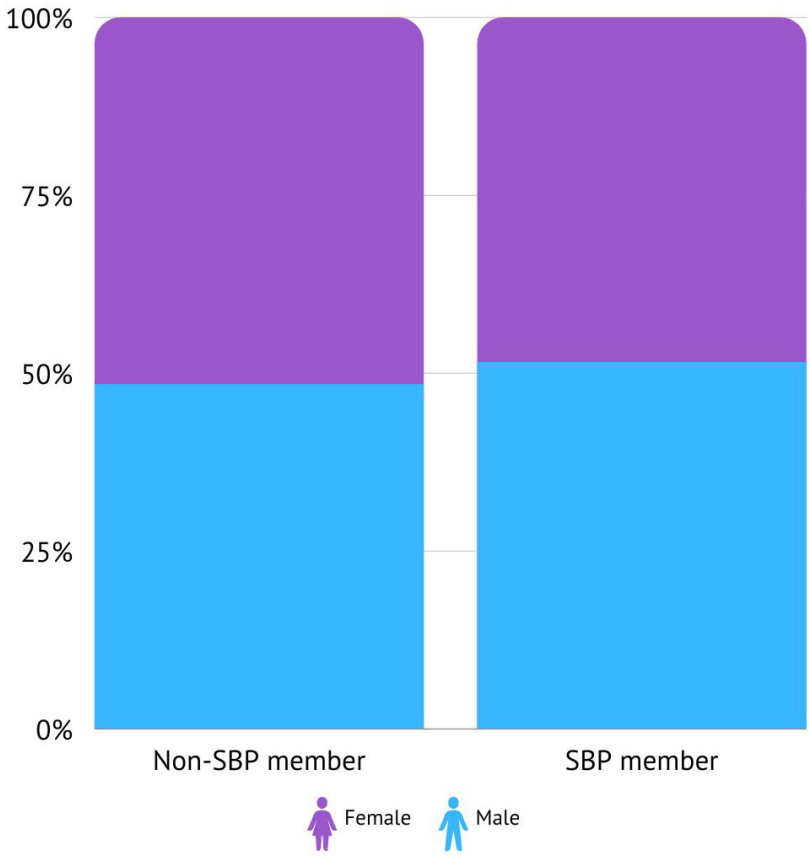

Figure 2. The online survey respondents of Brazilian paleontologists, *per* gender. **Abbreviation: SBP**, Brazilian Society of Paleontology.

Other demographic data of respondents

The survey also inquired about the sexual orientation of participants, revealing that 74.24% of respondents identified as heterosexual, 10.54% as bisexual, 7.49% as gay, 3.04% as pansexual, 1.41% as lesbian, 1.17% as asexual, and 2.11% chose not to answer. According to the survey, approximately 73.27% of respondents identified as White, 15.75% identified as Pardo (mixed race), 7.16% as Black, 2.4% as Yellow (Asian), and 1.4% as Indigenous. This demographic pattern is also observed in the Geosciences as a whole, which has been identified as the least diverse discipline in STEM over the past 40 years (Bernard & Cooperdock, 2018) and is predominantly composed of White individuals (Dutt, 2020; Berhe *et al*., 2022). Dutt (2020) argues that the lack of diversity in a field can make it less welcoming to minorities and increases the prevalence of implicit biases. Coupled with structural and social factors, the relative homogeneity in Geosciences reinforces the dominant culture, leading women, individuals from sexual and gender minorities, and Black and Hispanic individuals to leave the field at higher rates than the average student or practitioner, particularly in the USA.

In Brazil, the quota law 12.711/2012 (Brasil, 2012) was enacted to facilitate the admission of Black and Pardo students in public universities as a historical reparation to counteract the racial, social, and educational inequalities that still persist among this population after enduring 300 years of slavery in the country. Despite constituting the majority of the Brazilian population (56.2%; IBGE, 2024), Black and Pardo students are underrepresented in higher education, and occupy only 48.5% of places in public and private universities (Silva & Minhoto, 2023), with an even lower percentage of Black students engaged in scientific research. For instance, publicly available data of the Brazilian National Council for Scientific and Technological Development's (CNPq) Promotion Panel in Science, Technology, and Innovation show that, between 2017 and 2022, White students received 56.97% of all undergraduate research ("*iniciação científica*") scholarships from that funding agency, while Pardo and Black students were granted 28.44% and 8.35%, respectively (CNPq, 2025). This also reflects the underrepresentation of Black individuals in the academic sphere, particularly in graduate programs and among faculty members in Brazilian universities. A survey conducted by the Brazilian Black Science League in June 2020 indicated that among graduate students, 2.7% are Black, 12.7% are Pardo, 2% are Asian, less than 0.5% are Indigenous, and 82.7% are White (Hanzen, 2021). This analysis was based on data from the Lattes Platform of the National Council for Scientific and Technological Development (CNPq). As mentioned by UNIVALE (2022), the 2020 Education census also highlighted that only 15% of scientific production in Brazil is attributed to black researchers, and only 3% to black women.

Another Brazilian quota law, Law 12.990/2014 (Brasil, 2014), established that 20% of positions in federal public competitions, including faculty positions in public universities, should be reserved for self-declared Black or Pardo candidates. This legislation has been recently reviewed (Law 15.142/2025; Brasil, 2025) to 30%, which also includes Indigenous and quilombola populations. However, compliance with this quota for faculty positions has been inadequate, as demonstrated by Palma (2021). The author analyzed 2,391 notices between 2014 and 2017 and found that only 374 of these positions were reserved for Black candidates, representing just 3.18% of the vacancies. The research revealed that, out of the 11,744 vacancies

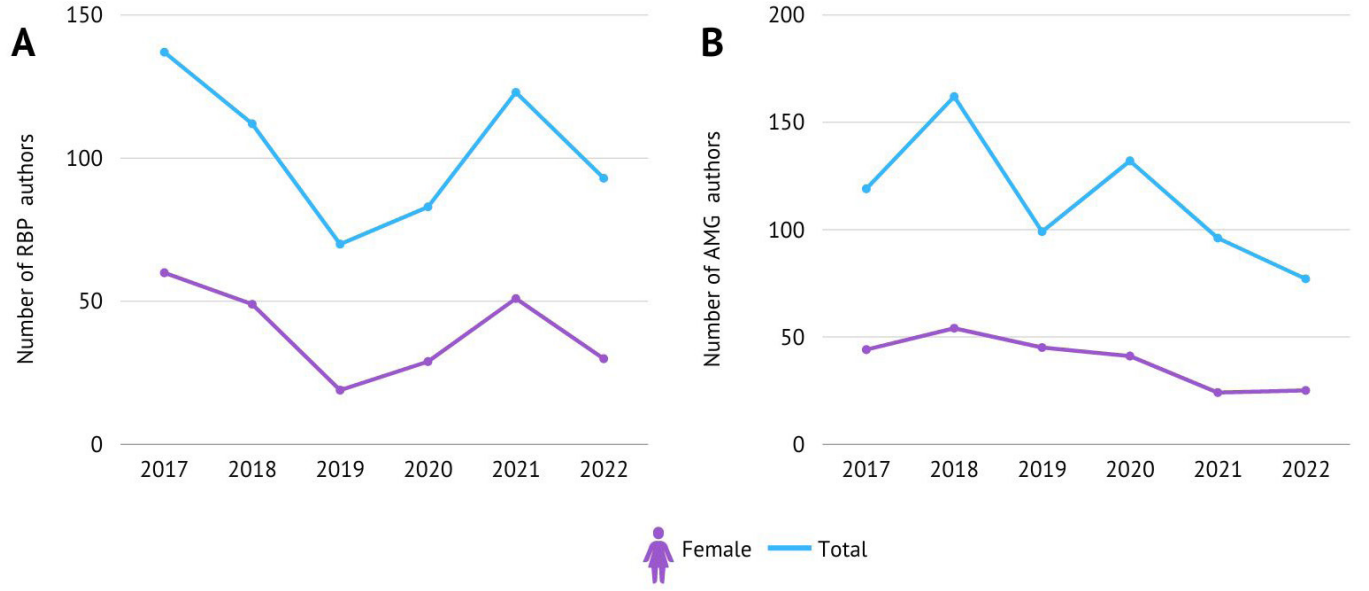

Figure 3. Temporal analysis of female participation in the authorship/co-authorship of publications in the **A**, *Revista Brasileira de Paleontologia* and **B**, *Ameghiniana* between 2017 and 2022.

offered in the analyzed selection processes for teaching positions in federal universities, 2,348 should have been reserved for Black candidates, indicating that 1,974 vacancies were not allocated according to the quota system.

Brazilian paleontologists are distributed across all geographic regions (Figure 4), with a notable scarcity of researchers in the Central-West region, which accounts for only 5.7% of the total. In contrast, the majority of paleontologists are concentrated in the Southeast region, representing 43.7% of the total (Figure 4). In the Southeast, there is a higher representation of male researchers, with 55.9%. Conversely, in all other regions, female researchers outnumber their male counterparts (Figure 4). This result was seen in other studies, indicating a significant disparity among the other regions (Sousa *et al*., 2022). Brazilian paleontologists working abroad represent 3.72% of the total of respondents, with 66.67% being male and 33.33% female.

Our research examined the academic backgrounds of respondents, revealing that most participants hold a doctoral degree or are currently pursuing one. Notably, among the respondents who reported themselves as professionals, there are proportionally more women with master's degrees and slightly fewer women with doctoral degrees compared to their male counterparts. This trend is also reflected in the student respondents of the survey (Figure 5). In various professions, women's participation, although often in the majority upon entry into undergraduate programs, diminishes notably as the career progresses to higher levels. This phenomenon, known as the "*Scissors Effect*", is a quantitative behavior responsible for substantial loss of women in science, alongside the "*Leaky Pipeline*" phenomenon (Menezes *et al*., 2017; Grogan, 2019). This effect is particularly pronounced in STEM disciplines, with Geosciences being the least diverse of them (Bernard & Cooperdock, 2018; Piccoli & Guidobaldi, 2021).

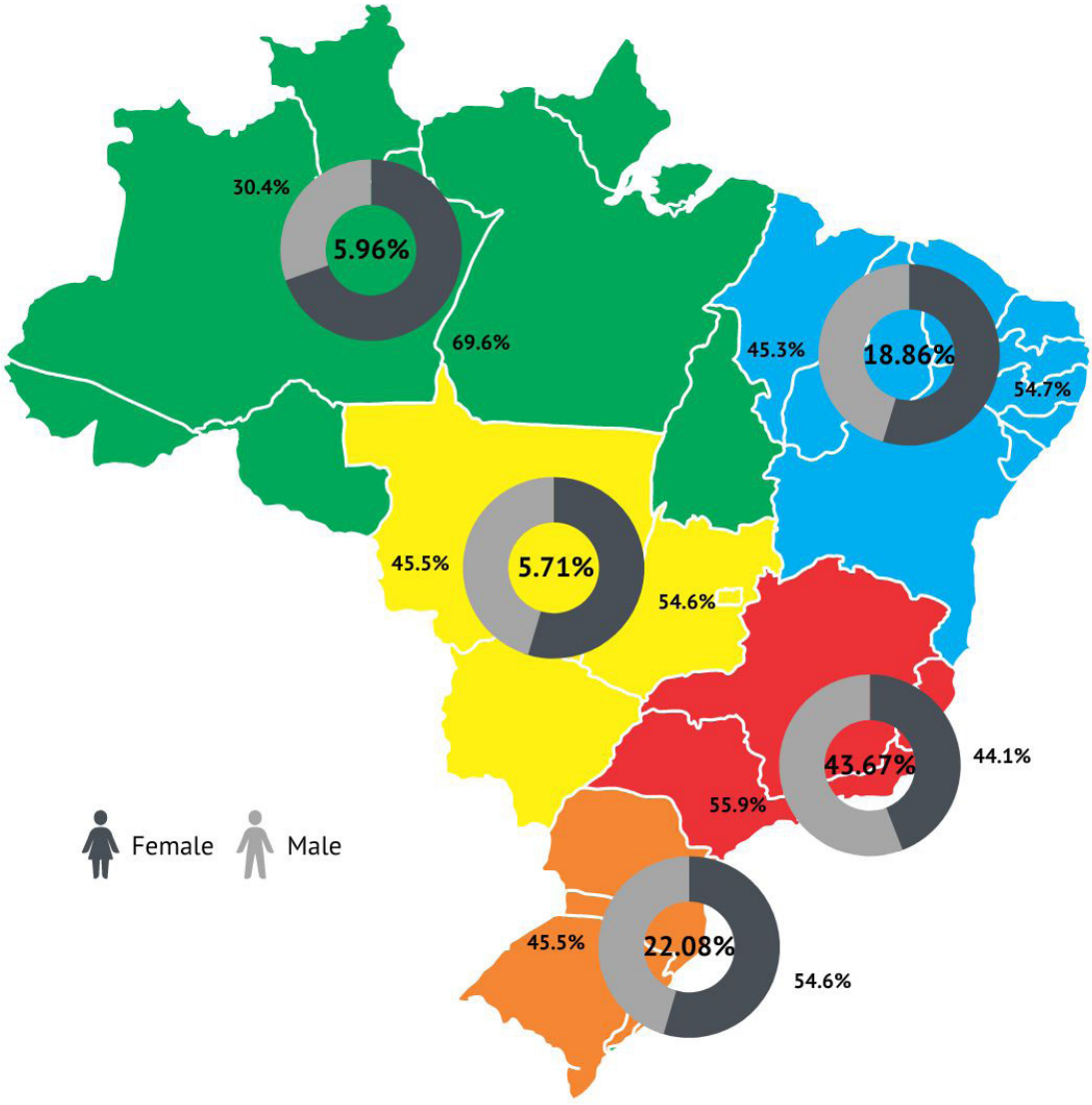

Figure 4. Geographic distribution of Brazilian paleontologists. Numbers inside the circles represent the ratio of respondents from each of the country's five geographic regions. Numbers next to the circles represent the ratios of male and female respondents *per* region.

Among the respondents affiliated with teaching and/or research, the majority are associated with federal institutions (65.2%), followed by state institutions (21.7%), municipal institutions (1.9%), and private institutions (7.5%). Faculty members in higher education represent 26.2% of respondents, and when combined with postgraduate students (25.8%), they constitute the majority of the data for this question (Figure 6). It is important to note that women comprise a significant portion of these groups. At the same time, female faculty members remain a minority in higher education. A slight increase in male students compared to female undergraduate students was observed, which may be attributed to gender bias in Paleontology related to the "*Leaky Pipeline*". Globally, women actively pursue bachelor's and master's degrees, representing 53% of graduates (Huyer, 2015). However, there is a significant drop in their numbers at the PhD level, with male graduates surpassing female graduates. This trend continues at the researcher level, where men now represent 72% of the global pool (Huyer, 2015). Our data, collected in 2021 during the second year of the COVID-19 pandemic, indicate that none of the women who responded to the survey had a postdoctoral scholarship at that time (see Figure 5B).

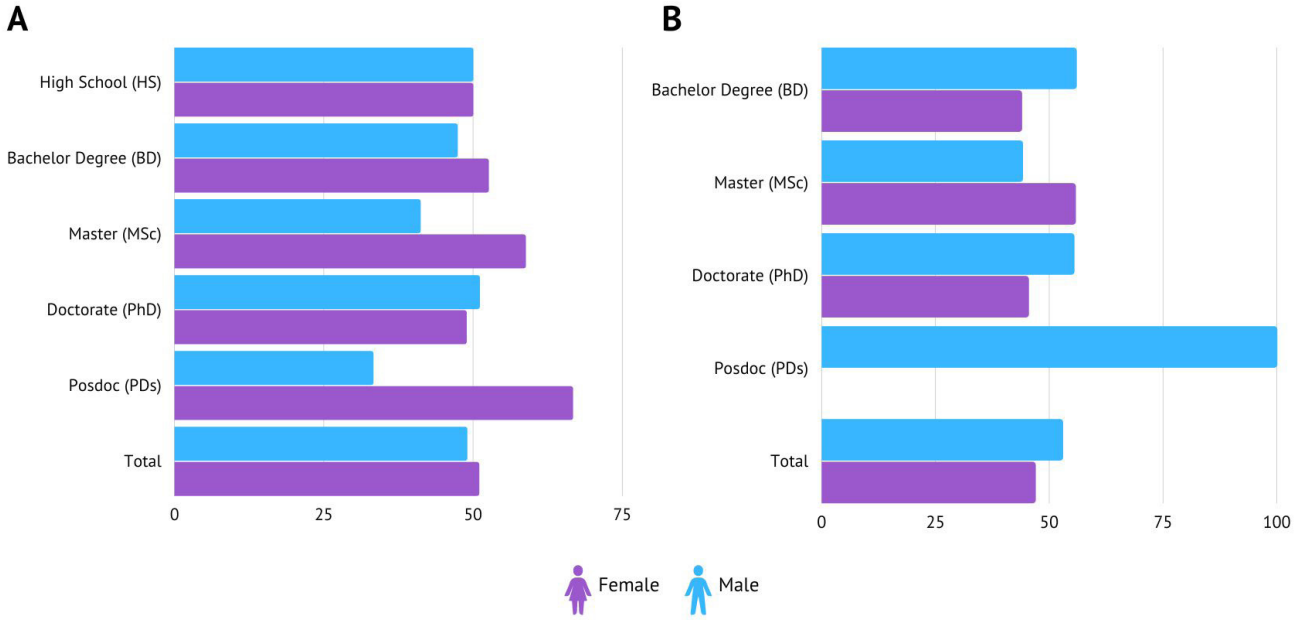

Figure 5. Percentage of the academic background of **A**, professional and **B**, student respondents, *per* gender.

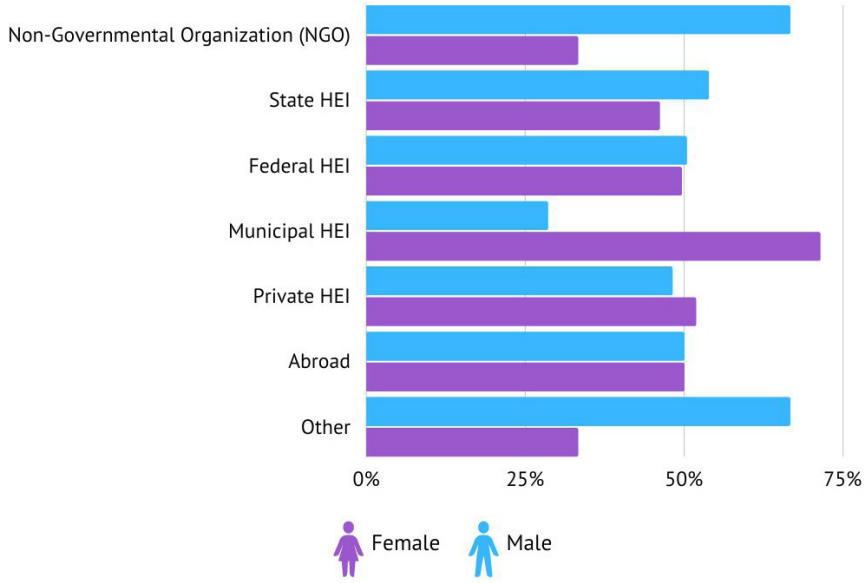

Figure 6. Percentage of Brazilian paleontologists affiliated with an Higher Education Institution **(HEI)** and/or research institution.

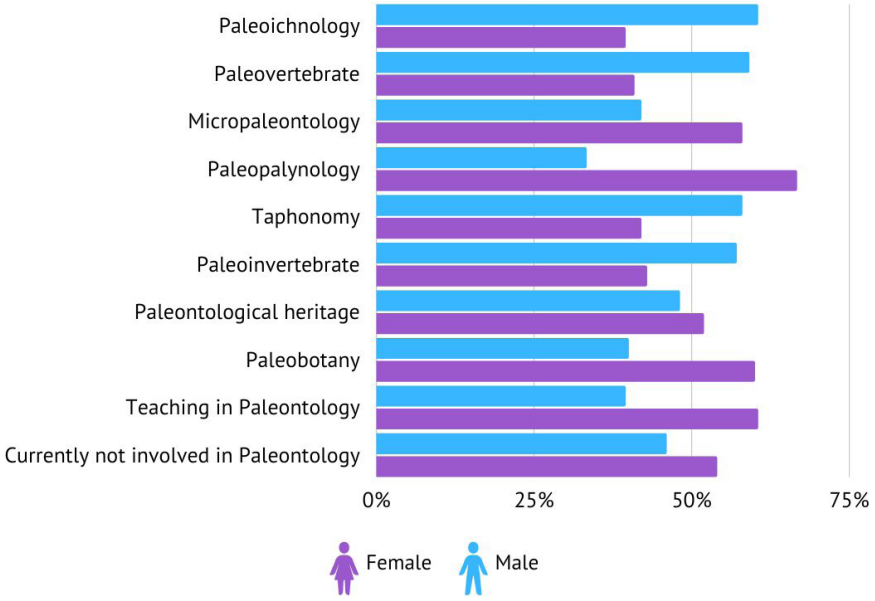

Figure 7. Areas of expertise in Paleontology among the respondents.

In other words, despite the high proportion of women in higher education, this does not necessarily translate into a more significant presence in research.

Regarding areas of expertise within Brazilian paleontology, women dominate fields such as: paleopalynology, micropaleontology, paleobotany, and teaching in paleontology. However, women are a minority compared to men in paleovertebrates, paleoichnology, taphonomy, and paleoinvertebrates (Figure 7), suggesting the existence of gender bias within specialty areas.

FINAL CONSIDERATIONS

In recent years, several studies have been published addressing gender bias and disparities in academia and science, particularly in STEM fields. These works have focused on the proportion and number of researchers by gender across countries and scientific areas, as well as on the impacts of parenthood and the COVID-19 pandemic on publication rates and citation metrics (h-index). They also explored the challenges of overturning societal perceptions that undervalue women scientists compared to their male counterparts (Elsevier, 2017; Staniscuaski *et al.*, 2020, 2021; Oliveira-Ciabati *et al.*, 2021; Slobodian *et al.*, 2021). An additional important issue discussed involves the role of professional and scientific societies in promoting equity, diversity, and inclusion among their membership (Chuliver *et al.*, 2021; Shiffman *et al.*, 2022).

This study sheds light on initial data regarding gender demographics in Brazilian paleontology, collected during 2021, in the second year of the COVID-19 pandemic. The focus is solely on presenting the first quantitative results related to the demographic and academic characteristics of Brazilian paleontologists, with other research questions – such as those concerning sexual and moral harassment and sexual violence in academic and educational settings – reserved for future studies.

Our results also show how female paleontologists from Brazil, although almost equally present in the early stages of the academic sphere, are still underrepresented, when compared to men, in the highest positions of scientific research. This evidences the urge to create repairing solutions to the "*Scissors Effect*" among Brazilian researchers. Our findings underscore the necessity of promoting policies of inclusion and equity, not only concerning gender but also regarding race and ethnicity in Brazilian paleontology. As opinion leaders, academics, and intellectuals from Brazilian public or private institutions, we must support the debate within higher education institutions about the importance of affirmative actions that ensure greater diversity in academia and science.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article.

ACKNOWLEDGEMENTS

We dedicate this work to all victims of harassment and gender violence in STEM, especially to the undergraduate and graduate students who have been hindered in their academic journeys due to the impacts and consequences of actions perpetrated by those in positions of power within academia, universities, and research institutes. This work received the support of various researchers, and while we cannot name them all, we express

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AUTHOR CONTRIBUTIONS

Annie Schmaltz Hsiou, Elizete Celestino Holanda, Ana Emilia Quezado de Figueiredo, Paula Dentzien-Dias, Taissa Rodrigues: conceptualization, writing – original draft, editing, visualization, investigation, revision. Livia Oliveira-Ciabati: formal analysis, data curation, conceptualization. Ednair Rodrigues do Nascimento, Aline Marcele Ghilardi, Andressa Masetto, Dimila Mothé Cordeiro dos Santos, Joyce Celerino de Carvalho, Lucy Gomes de Souza, Sara Coralina Pereira Lima, Etiene Fabbrin Pires Oliveira, Tamiris Morilla, Arianny Storari: contributed to various aspects of this work, gave their final approval for publication, and agreed to be held accountable for the work performed therein.

DECLARATION OF AI USE

We have not used AI-assisted technologies to create, review, or any part of this article.

ETHICS

This study was approved and recorded in "Platform Brazil," the national registry for human research managed by the National Council of Ethics in Research, within the scope of the project "Brazilian Paleontology Gender Profile" (CAAE: 37147620.4.0000.5407; Approval no. 4.297.391), coordinated by ASH, in November 2020.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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