

Earth Sciences

Original article

Two centuries of Colombian paleontology

Dos siglos de estudios paleontológicos en Colombia

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Abstract

Paleontological research on Colombian material has been conducted since 1838. Here, we compiled a database of all published articles through May 2025 to assess temporal trends and changes in Colombian paleontological research. We identified 842 paleontological articles, most of which were published after 1960. Starting in 2000, publications increased significantly, alongside a shift in authorship and research topics. While the 1960s through the 1990s were characterized by publications primarily involving international researchers, mostly working alone or in small teams and focusing on taxonomy and biostratigraphy, from 2000 to 2025, publications increasingly involved Colombian researchers, with increasing participation of women and larger, multidisciplinary teams that have addressed a large variety of topics, including paleoclimate, paleoecology, phylogeny, and large-scale meta-analysis. Although Colombian funding for paleontological research remains minimal, international funding and the expansion of global collaborative networks involving Colombian researchers appear to have helped sustain the growth of paleontological research. The data indicate that Colombian paleontology is undergoing a golden era, with immense potential, as only a fraction of the country has been explored.

Keywords: Bibliographic analysis; Colombian authorship; Colombian funding; paleoecology; taxonomy; women's inclusion.

Resumen

Desde 1838 se han adelantado investigaciones paleontológicas basadas en fósiles colombianos. Para estudiar los patrones temporales de diversas variables y comprender el futuro de la paleontología en el país, elaboramos una base de datos que incluye todos los artículos publicados hasta mayo de 2025. Nuestros resultados muestran que se publicaron 842 artículos paleontológicos, la mayoría de ellos a partir de 1960. Además, en la década de 2000 y siguientes, se observó un aumento significativo de las publicaciones, acompañado de cambios en los autores y en las áreas de investigación. Mientras que entre las décadas de 1960 y 1990 las publicaciones correspondieron a autores extranjeros que trabajaban en solitario o con pequeños equipos y se centraban en la taxonomía y la bioestratigrafía, durante el periodo de 2000 a 2020 las publicaciones empezaron a ser dominadas por paleontólogos colombianos con una notable participación femenina y trabajos en grandes grupos multidisciplinarios que abordaban preguntas más cercanas a los procesos biológicos y geológicos como el paleoclima, la paleoecología y los metaanálisis paleoecológicos. Además, notamos que, aunque la financiación colombiana ha sido mínima, la producción científica se ha mantenido gracias a la sólida colaboración con equipos internacionales de los investigadores nacionales. Los datos indican que la paleontología colombiana atraviesa su época dorada y tiene un gran potencial, dado que solo se ha explorado una pequeña fracción del país.

Palabras clave: análisis bibliográfico; autores colombianos; fondos colombianos; paleoecología; taxonomía; inclusión de la mujer.

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Introduction

Colombia is one of the most biodiverse countries in the world (Myers *et al.*, 2000). How this biodiversity arose and is maintained has been the subject of numerous studies over the past century (Cuatrecasas, 1958; Pérez-Escobar *et al.*, 2017; González-Orozco, 2023; Palacios-Hurtado *et al.*, 2025). Regardless of the ecological mechanisms driving biodiversity, geological time plays a major role in generating it, as species do not originate or go extinct instantaneously; rather, this process unfolds over geological time. Paleontology studies the evolution of biota, along with its landscape and climate, over long periods of time. Using a paleontological database focused on Colombia and several descriptive tags attached to each article, we investigated multiple trends in paleontological research, including how the size of research teams has changed, what drives local participation (i.e., Colombian authorship), what drives inclusive participation, and how publication patterns have changed over time across paleontological topics, including geological time, geographic location, and research interests, among other questions.

Methods

The database

We developed a paleontological reference database using the Mendeley Reference Manager (2.148.0, 2026; Elsevier, www.mendeley.com) that included all scientific publications using Colombian fossils as their primary component from 1838 (von Buch, 1838) through May 2025 (Figure 1) (Supplementary Material 1, <https://doi.org/10.60635/C35341>). Several of these studies were published in the *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* (Mier-Restrepo, 1930; Thenius & Burgl, 1957; Villarroel, 1998; Villarroel, 2000; Pardo-Jaramillo, 2010; Pardo-Jaramillo, 2012; Páramo-Fonseca, 2013; García *et al.*, 2022; Jaramillo *et al.*, 2022; Cárdenas *et al.*, 2023; Mantilla-Meluk *et al.*, 2023; Pardo-Trujillo *et al.*, 2023; Plata-Torres *et al.*, 2023; Cortés, 2024; Pelegrin, 2024; Pérez-Lara *et al.*, 2024).

We added descriptors to the keywords field for each publication, including the paleontological discipline used in each paper (biostratigraphy, functional morphology, invertebrate paleontology, micropaleontology, paleobotany, paleoclimatology, paleoecology, palynology, vertebrate paleontology, systematics, and taxonomy), the geographic location, the geological time interval (i.e., eras, periods, or stages), Colombian authorship (Colombian authors and Colombian as first authors), gender authorship (women as first authors and women among the authors), and whether the study reported funding from Colombian sources. We then used a combination of bibliometric data extraction, natural language

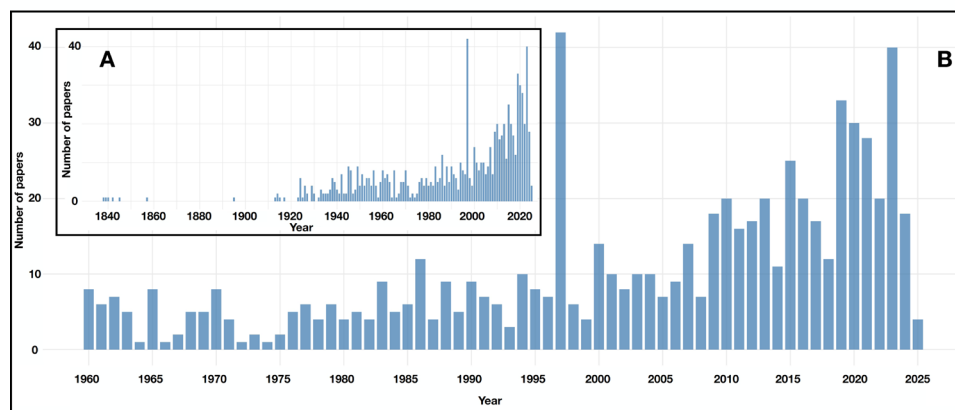


Figure 1. Time series of Colombian paleontological papers. **A.** Period from 1838 to 2025. **B.** Period from 1960 to 2025

processing (i.e., keyword extraction), descriptive statistics, and Generalized Linear Mixed Models (GLMMs) to assess temporal patterns in Colombian paleontological research. All analyses were performed in the statistical computing language R (**R Core Team**, 2025; www.R-project.org).

The database was imported from a BibTeX file using the bib2df package (version 1.0) for consistent data manipulation. The data were then converted to tibble format using the tidyverse package (**Wickham et al.**, 2019). To handle the nested list structures inherent in BibTeX files (e.g., multiple authors, multiple keywords), we applied the supply function (Supplementary material 2, <https://doi.org/10.60635/C35341>).

Descriptive statistics

To identify temporal patterns related to changes in Colombian paleontological publications from 1960 to 2025, we calculated the number of papers per year (Supplementary Material 3A, <https://doi.org/10.60635/C35341>), the percentage of Colombian authorship by decade (Supplementary Material 3B, <https://doi.org/10.60635/C35341>), the percentage of publications with women as authors and first authors by decade (Supplementary Material 3C, <https://doi.org/10.60635/C35341>), the proportion of papers of Colombian funding by decade (Supplementary Material 3D, <https://doi.org/10.60635/C35341>), the percentage of papers related to ‘traditional’ paleontology (biostratigraphy and taxonomy) vs. ‘modern’ paleontology (functional morphology, paleoclimatology, paleoecology, systematics) by decade (Supplementary Material 3E, <https://doi.org/10.60635/C35341>), the proportion of papers by geological periods by decade (Supplementary Material 3F, <https://doi.org/10.60635/C35341>), the percentage of papers by geographic distribution by decade (Supplementary Material 3G, <https://doi.org/10.60635/C35341>), the distribution of authors per paper by decade (Supplementary Material 3H, <https://doi.org/10.60635/C35341>), and the percentage of papers published in high impact, specialized, and local journals (Supplementary Material 3I, <https://doi.org/10.60635/C35341>).

Publications were classified according to the paleontological approach, the geological time, and the geographic area using the descriptors recorded in the database keywords field. We defined ‘traditional’ paleontology as topics associated with biostratigraphy and/or taxonomy, whereas ‘modern’ paleontology as topics associated with functional morphology, paleoclimatology, paleoecology, and/or systematics. These categories are not mutually exclusive and, consequently, a publication may contain both ‘traditional’ and ‘modern’ paleontology descriptors. Therefore, the percentages of this analysis are not expected to sum to 100%.

Geological time was classified according to the geological intervals associated with the fossils investigated in each publication, and publications were grouped according to the geological periods in each study. Geographic areas were classified using the geographic-location descriptors recorded for each publication. The complete classification of individual publications and the R scripts used to extract and summarize these categories are provided in Supplementary Materials 1 and 3, respectively (**Jaramillo et al.**, 2026).

Journal categories

Journals were classified into four categories based on impact and specialization: high impact (e.g., Nature, Science, PNAS, Science Advances), specialized (paleontology journals such as the Journal of Vertebrate Paleontology, Cretaceous Research, Journal of South American Earth Sciences, Palaeogeography-Palaeoclimatology-Palaeoecology, Review of Paleobotany and Palynology, Historical Biology, Geodiversitas, etc.), local (Colombian journals in Spanish), and unknown (internal reports or missing journal information).

Generalized Linear Mixed Models (GLMMs)

We wanted to test three main questions using a GLMM as follows:

1. Does Colombian funding increase the likelihood that an article has Colombian authors? To answer this, we built a GLMM in which the outcome was whether the

paper included at least one Colombian author, and the main predictor was whether the study reported Colombian funding.

2. Are articles with Colombian authors more likely to include women as authors? To answer this, we built a GLMM in which the outcome was whether the paper included at least one woman author, and the main predictor was whether the paper included at least one Colombian author.
3. Is ‘traditional’ paleontology declining while ‘modern’ paleontology increasing through time? Here we built GLMMs specifically looking at four temporal patterns: (1) whether ‘traditional’ paleontology declined over time, (2) whether ‘modern’ paleontology increased over time, (3) whether research classified exclusively as ‘traditional’ paleontology declined over time, and (4) whether research classified exclusively as ‘modern’ paleontology increased over time. For these models, the response variables represented the presence or absence of the corresponding paleontological approach in each publication, and time was included as the main predictor.

We used GLMMs to detect patterns rather than simple linear correlations because they provide a flexible approach for analyzing non-normal data when random effects are present (Bolker *et al.*, 2009). Besides, GLMMs provide interpretable effect sizes, Odds Ratios for binomial models, and Rate Ratios for Poisson models (Coxe *et al.*, 2013). Our data were not normally distributed, as the number of authors per paper is a count variable (Poisson distribution), while binary variables such as Colombian authorship, female authorship, Colombian funding, and paleontological research topics follow a binomial distribution.

Because papers were grouped according to journal category (high impact, specialized, local, and unknown), journal category was included as a random intercept in all GLMMs to account for non-independence and journal-level variation in publication practices, including differences in audience, editorial policies, and publication standards that could influence authorship patterns, research topics, and research-team composition.

We report Odds Ratios (OR), a metric that indicates how likely something is to happen when a predictor changes by one unit. If $OR = 1$, there is no effect; if $OR < 1$, the predictor decreases the chance; if $OR > 1$, the predictor increases the chance. The packages used were lme4 (running the GLMMs) and tidyverse (data manipulation). We excluded the 2025 dataset from the analysis because it includes publications only through May and, therefore, it does not cover a full year of publication data (Supplementary Material 2).

Results

Publication trends

In total, 842 articles were published from 1838 to 2025, but most (690, 81%) were published from 1960 to 2025 (**Figure 1A**). From 1960 to date, there were publications every year (**Figure 1B**). In 1997, more articles were published than in any other year (42), followed by 40 articles in 2023 and 33 articles in 2019 (**Figure 1B**). Since 1960, the mean number of publications per year has been 10.5, and the growth rate was 192% (1960s: 48 articles to 2020s: 140 articles). Because most paleontological activity has occurred since 1960, we restricted our analysis to this period, as including the full 188-year dataset could obscure patterns emerging in recent decades.

Colombian authorship (1960 to 2025)

The number of articles with Colombian authors was 420 (60.9%), and the number of articles with Colombian researchers as first authors was 325 (47.1%). There has been a steady increase in Colombian authorship (i.e., the presence of Colombian authors), from 31% in the 1960s to 90% in the 2020s (**Figure 2A**), and also in Colombians as first authors, from 25% in the 1960s to 72.9% in the 2020s (**Figure 2A**), with a pronounced increase since the 2000s (**Figure 2A**).

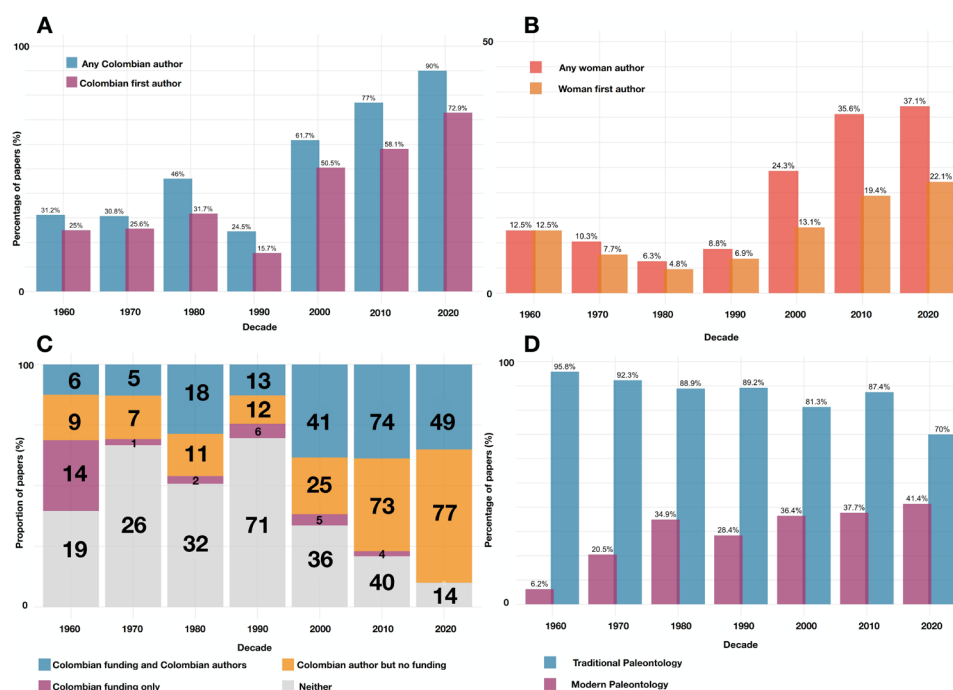


Figure 2. Distribution of authorship factors measured by decade from 1960 to 2025. **A.** Colombian authorship. **B.** Women's participation as authors and first authors. **C.** Colombian funding. **D.** Traditional vs. modern paleontology. Panels **A** and **B** use different y-axis scales because the values for women's participation are substantially lower, allowing temporal changes within each dataset to remain visible. Traditional and modern categories are not mutually exclusive; publications containing keywords associated with both approaches were counted in both categories. Consequently, percentages are not expected to sum to 100%.

Women's participation (1960 to 2025)

The number of articles with at least one woman author was 169 (24.5%), and the number of articles with women as first authors was 101 (14.6%). There has been a steady increase in publications with at least one woman author, from 12.5% in the 1960s to 37.1% in the 2020s (**Figure 2B**), and in publications with women as first authors (1960s = 12.5% to 2020s = 22.1%) (**Figure 2B**), with a pronounced increase since the 2000s (**Figure 2B**). Although the values are lower, the overall trend mimics the Colombian authorship pattern.

Colombian funding (1960 to 2025)

Of the 690 articles published, 206 (29.9%) had both Colombian funding and Colombian authors, while 32 (4.6%) had Colombian funding but no Colombian authors. The articles with Colombian authors but no Colombian funding were 214 (31%), and those with neither Colombian authors nor Colombian funding numbered 238 (34.5%). Nearly two out of three articles have at least one Colombian author, but only about one out of three articles acknowledge Colombian funding. There was a change in this pattern beginning in the 2000s (**Figure 2C**), with an increase in both the participation of Colombians and Colombian funding. This pattern became even more pronounced in the 2020s, with an increase in Colombian authorship but without a concomitant increase in funding from Colombian sources (**Figure 2C**). Lastly, international teams that lack Colombian participation have drastically decreased: whereas published research between 1960 and 1990 was dominated by international teams without Colombian researchers, the pattern has since reversed, with teams including Colombian researchers dominating published research studies over the past 25 years (14 papers) (**Figure 2C**).

Traditional vs. modern paleontology (1960 to 2025)

Our results showed that ‘traditional’ paleontology (taxonomy and biostratigraphy topics) has decreased by 25.8%, from 95.8% of articles in the 1960s to 70% in the 2020s (**Figure 2D**). In contrast, modern’ paleontology (functional morphology, paleoclimatology, paleoecology, and systematics) increased by 35.2%, rising from 6.2% of articles in the 1960s to 41.4% in the 2020s (**Figure 2D**). This change increased rapidly after 2000 and even more in the 2020s.

Geological time (1960 to 2025)

About 60% of articles focused on either the Neogene ($n = 237$; 34%) or the Cretaceous ($n = 211$; 30.6%), and the remaining 40% focused on the Quaternary ($n = 99$; 14.3%), Paleogene ($n = 67$; 9.7%), Paleozoic ($n = 34$; 4.9%), Cenozoic not differentiated ($n = 6$; 0.9%), Jurassic ($n = 6$; 0.9%), and Triassic ($n = 4$; 0.9%). An additional 3.8% of articles lacked geological time. We subdivided the Cretaceous and Neogene into several bins, including Late Cretaceous, Early Cretaceous, Cretaceous unspecified, Middle Miocene, Early Miocene, Pliocene, and Neogene unspecified (**Figure 3A, B**). The Cretaceous studies showed an equal level of interest in the Early and Late Cretaceous (**Figure 3A**), while the Neogene studies are strongly dominated by the Middle Miocene ($n = 224$) (**Figure 3B**).

Geographic areas (1960 to 2025)

The region with the most articles among the Cretaceous studies is Boyacá ($n = 99$; 52.4%) followed by Santander ($n = 33$; 17.5%), Cundinamarca ($n = 15$; 7.9%), Huila ($n = 14$; 7.4%), Tolima ($n = 9$; 4.8%), Antioquia ($n = 7$; 3.7%), Valle del Cauca ($n = 5$; 2.6%), the Andean region unspecified ($n = 5$; 2.6%), and the Caribbean region ($n = 2$; 1.1%) (**Figure 4A**). The region with more articles in the Neogene is Huila ($n = 167$; 73.2%), followed by the Caribbean region ($n = 34$; 5.3%), Cundinamarca ($n = 12$; 5.3%), the Amazon region unspecified ($n = 6$; 2.6%), Tolima ($n = 4$; 1.8%), Antioquia and Valle del Cauca ($n = 2$ for each area; 1.8% both), and Boyacá ($n = 1$; 0.4%) (**Figure 4B**).

Number of authors per paper (1960 to 2025)

The number of authors per paper increased from a mean of 1.2 in the 1960s to 5.4 in the 2020s (**Figure 5**), reflecting a 354.1% increase (linear model $r^2 = 0.373$; p -value < 0.001). The number of authors per article has increased rapidly since the 2000s and has continued to grow up to the present (**Figure 5**).

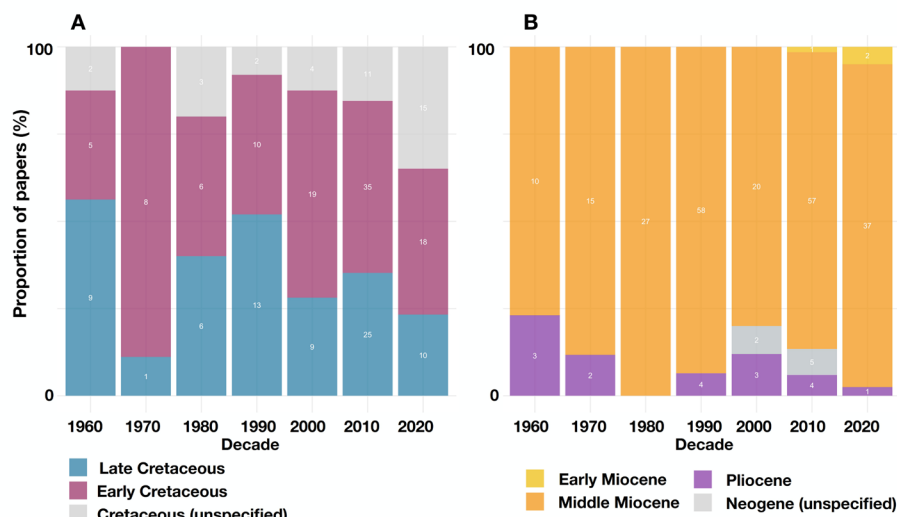


Figure 3. Proportion of publications that focus on the preferred geological time periods in Colombia from 1960 to 2025. **A.** Cretaceous period. **B.** Neogene period

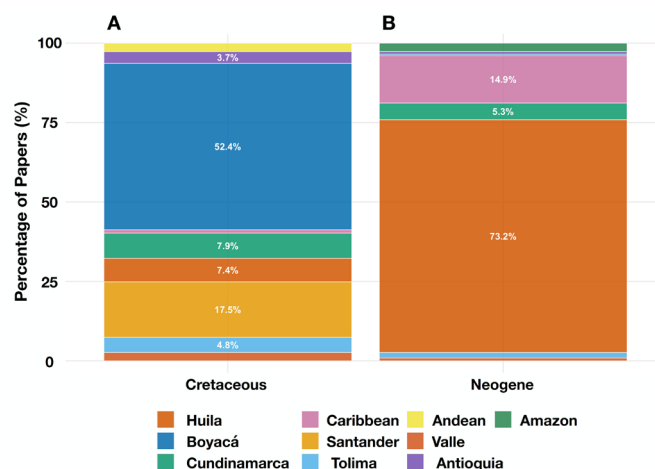


Figure 4. Percentage of articles published referring to geographical regions of Colombia from 1960 to 2025. **A.** Cretaceous. **B.** Neogene.

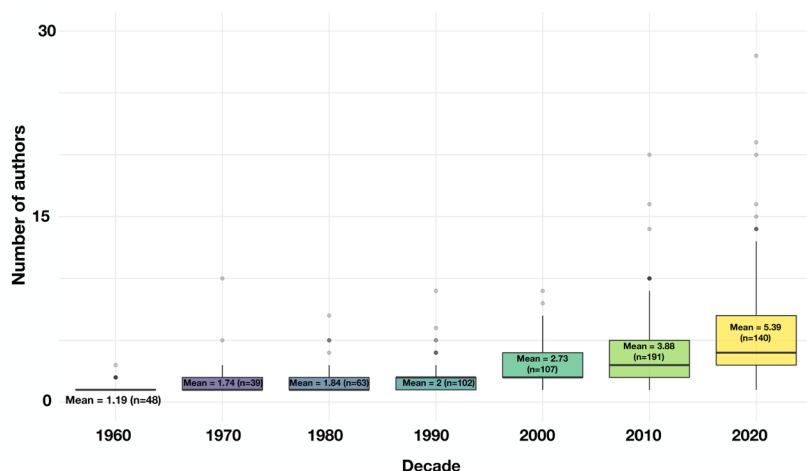


Figure 5. Boxplots showing the number of authors per article from 1960 to 2025

Journals (1960 to 2025)

Local journals dominated publications in the 1960s (66.7%) (Figure 6). However, since the 1970s, specialized journals have been increasingly replacing local journals, ranging between 51% and 70% in every subsequent decade (Figure 6). Colombian paleontology has a constant presence in high-impact journals (Figure 6).

GLMMS

We tested three hypotheses. H1: Colombian funding strongly enhanced Colombian authorship (OR = 10.22, $p < 0.001$). H2: Colombian author teams significantly increased the likelihood of women's authorship (OR = 2.05, $p = 0.003$), with team size also contributing positively (OR = 1.42, $p < 0.001$). H3: 'Traditional' paleontology (taxonomy + biostratigraphy) declined significantly over time (OR = 0.63, $p < 0.001$), while 'modern' paleontology (paleoecology + paleoclimatology + functional morphology + systematics) increased (OR = 1.43, $p < 0.001$). Colombian funding showed opposing effects on research topics: it was associated with an increase in 'traditional' research, although this effect was not statistically significant (OR = 1.58, $p = 0.054$), and a significant decrease in 'modern' research (OR = 0.64, $p = 0.015$).

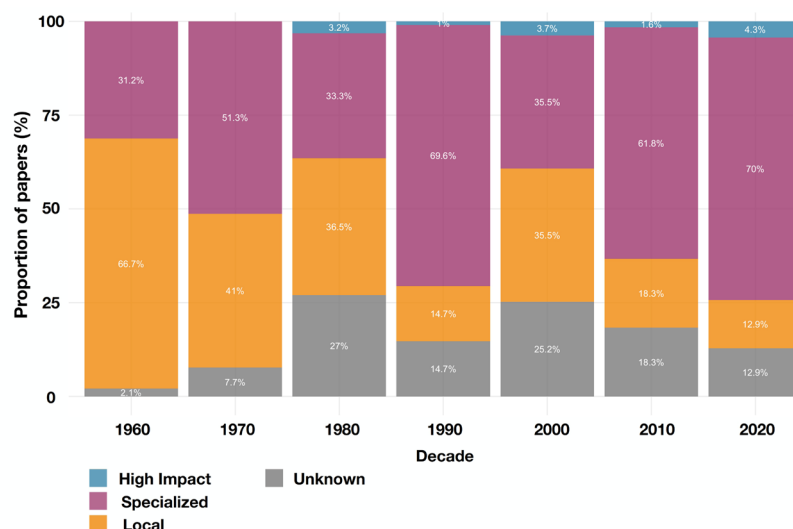


Figure 6. Proportion of articles published in high-impact, specialized, and local journals from 1960 to 2025

Discussion

Research on Colombian fossils began more than 188 years ago (**von Buch**, 1838), but it remained stagnant for almost 120 years, with minimal scientific output and long periods with no articles (76 years) (**Figure 1A**). In the 1960's, this scenario changed, with a significant increase in paleontological research (**Figure 1**). During this period, several geology schools were established (e.g., the Department of Geology at Universidad Nacional de Colombia in Bogotá), and the Colombian Geological Survey was established. This period also saw an influx of well-prepared researchers to the country, alongside locally trained scientists. A single event represented the publication of the seminal work *Vertebrate Paleontology in the Neotropics. The Miocene fauna of La Venta, Colombia* (**Kay et al.**, 1997), a book containing multiple articles related to La Venta, produced the highest peak in Colombian paleontological publications through time (**Figure 1A**). Over the following decades, Colombian publications on paleontological research showed a sustained increase (**Figure 1A, B**). This trend became particularly pronounced from 2000 onward (**Figure 1B**), accompanied by transformation in the nature of paleontological research in the country.

Since the 2000s, the participation of Colombian researchers in paleontological publications has increased significantly, both as coauthors and first authors (**Figure 2A**). A similar time pattern is observed for women's participation (**Figure 2B**), with at least one woman participating as an author in almost half of the publications produced during the 2020s, a pattern also reported by **Cortés** (2024). Publications involving Colombian author teams were also significantly more likely to include at least one woman (OR = 2.05, $p = 0.003$). These results, however, should be interpreted within the structure of our dataset. Our descriptors record whether a publication includes at least one woman and whether a woman is the first author, rather than the proportion of individual authors who are women. Therefore, the observed increase reflects greater participation of women across publications but cannot be interpreted as an estimate of the overall representation of women within Colombian paleontology or as evidence of gender parity. Similarly, our data do not allow us to determine whether the increase in women's participation has occurred at the same rate as the broader increase in Colombian authorship. Addressing gender representation at the level of individual researchers and author teams would require a dedicated analysis beyond the scope of the present dataset. Despite this

limitation, the time pattern since the 2000's contrasts strongly with the previous period, when most studies were conducted without the participation of Colombians and/or women (**Figure 2A-C**).

Several factors may have produced this shift. One is the doctoral training program sponsored by Colciencias (today's Ministry of Science), which received substantially increased funding in the late twentieth century and gave Colombian researchers opportunities to pursue graduate studies abroad in a variety of disciplines, including paleontology. Nevertheless, only four currently active Colombian paleontologists received their doctoral training with Colciencias funding, while 36 were supported by scholarships from foreign universities in countries such as Argentina, Brazil, Germany, México, Switzerland, and the United States.

Therefore, this evolution suggests a multigenerational process. During the 1990s, Colombian paleontologists who trained abroad, including those supported by Colciencias, began establishing international scientific connections. During the 2000s, these connections developed into broader collaborative networks that created training, research, and scholarship opportunities for a new generation of Colombian paleontologists. In the next decades, these networks have continued to expand and diversify, providing further opportunities for younger researchers. Thus, investments in scientific training made several decades ago may have produced effects that became increasingly visible only over time.

Today, more than 40 active Colombian paleontologists conduct research on Colombian material at institutions worldwide, reflecting the expansion and consolidation of the international networks that began developing in earlier decades. Paleontological research has therefore continued to grow even as Colombian funding for the field has declined (**Figure 2C**). This time pattern suggests that the international networks developed since the 1990s have become an important mechanism for sustaining Colombian paleontological research despite reductions in domestic funding.

There are numerous paleontological questions that require analyses and techniques beyond the taxonomic study of fossils (what we have heretofore called 'modern' paleontology). These include investigating biotic responses to extreme events such as global warming or mass extinction, analyzing the role of ancient ecosystems in biogeochemical cycles, developing new quantitative paleotemperature proxies, exploring the functional morphology of extinct organisms, and examining the role of biomes in constructing global climate circulation models. These questions are reflected in the shift in paleontological interest observed since the 2000s (**Figure 2D**). Although there is still interest in taxonomic and biostratigraphic studies (the 'bread and butter' of paleontology), there is a growing interest in novel questions, a trend well-reflected in the publication data (**Figure 2D**). Our GLMM results showed that 'modern' paleontology was associated with a significant increase in the publication record over time ($OR = 1.43$, $p < 0.001$), confirming that this is not merely a statistical artifact but a substantial and meaningful change in research culture.

'Modern' paleontology requires specialized expertise in different areas, leading to interdisciplinary approaches that bring together researchers from different fields. This is reflected in the number of authors per article, which has steadily increased since the 1960s, with a significant jump in the 2000s (**Figure 4**) and a strong time effect (67% increase per decade). We have shifted from a model of solitary researchers toward multidisciplinary teams, reflecting a global trend in scientific research (**Wuchty *et al.*, 2007**).

Colombian funding showed divergent effects: it may have increased the prevalence of 'traditional' paleontology ($OR = 1.58$, $p = 0.054$) while decreasing that of 'modern' paleontology ($OR = 0.64$, $p = 0.015$), suggesting that projects sponsored by Colombian agencies (e.g., ANH, Colombian Geological Survey, Ecopetrol, ICPET) tend to support biostratigraphic and taxonomic studies, while the modern questions are supported by strong international networks.

Most paleontological research is concentrated in a few geographic areas and geological time periods. The most important region is the La Venta site (Tatacoa Desert, Huila) and its remarkable Middle Miocene fossil record (**Carrillo *et al.*, 2023**), which has been studied for more than a century. This region is so prolific that a South American Mammal Zone (SALMA), the Laventan, was named after it (**Madden *et al.*, 1997**). Although La Venta is the most studied region in Colombian paleontology, research there remains in its infancy. La Venta has 19 fossiliferous stratigraphic levels, but researchers have systematically sampled only three (**Mora-Rojas *et al.*, 2023**). Together, all the paleontological studies from La Venta today show ~70 species, far from a diversity plateau. This means that the exploration of the site is still in its early stages despite over 100 years of research. The second most studied region and geological period is the Cretaceous of Boyacá. Extensive outcrops, varying degrees of deformation that provide access to sedimentary rocks from different ages, and its relative safety have allowed paleontological researchers to study its rich fossil record. This includes large marine reptiles (**Cortés *et al.*, 2021**; **Córtés & Páramo-Fonseca, 2018**; **Páramo-Fonseca *et al.*, 2018**), crocodiles (**Cortés *et al.*, 2019**), turtles (**Cadena, 2015**; **Cadena & Parham, 2015**), ammonites (**Etayo-Serna, 1968**; **Etayo-Serna, 1979**; **Patarroyo, 2000**), crabs (**Luque *et al.*, 2020**), among many other taxa.

Most of the country remains unexplored, despite its rich paleontological record. For example, dinosaur remains from Serranía del Perijá in La Quinta Formation (**Rincón *et al.*, 2021**), numerous fossil sites in Antioquia (**Valencia-Giraldo *et al.*, 2016**), as well as Guajira and Cesar, have a rich Cenozoic record that includes both plants and animals, marine and terrestrial (**Carvalho *et al.*, 2011**; **Herrera *et al.*, 2019**; **Moreno *et al.*, 2015**; **Hendy *et al.*, 2015**). There are numerous promising regions across the country yet to be thoroughly investigated, including the Cretaceous between Sibundoy and Mocoa in Putumayo, the Albian coal, the leaves and tree trunks of the Upper Magdalena Valley (Alpujarra region), the Barremian in the San Felix Valley in Antioquia, the Hauterivian of Campo Hermoso, the Guaduala Formation in Tolima and Huila, the Maastrichtian Umir Formation in Santander, the Paleocene of Cesar, the Eocene of Tolú Viejo in Montería, the Oligocene of Amagá, the Miocene of Chiribiquete, the Pliocene of Puerto Berrio and the Cauca Valley, the Pleistocene dunes in Vichada, and the Pleistocene-Holocene fossil reefs in Barranquilla, Cartagena, and San Andrés.

Conclusions

Paleontological research on Colombian material is experiencing a golden age. After 188 years of research, the last few years have produced the highest volume of paleontological literature ever produced on Colombian fossils. Paleontological research increased significantly since the 1960s, coinciding with the creation of Colombia's first geology schools and the Colombian Geological Survey. The 2000s saw a rapid increase that has continued to grow to this day. Over the last 25 years, not only has the number of articles increased, but the composition of their authors has also shifted considerably. While research from the 1960s through the 1990s was primarily conducted by international researchers, often working alone, research from the 2000s through the 2020s has increasingly involved Colombian researchers, with increasing participation of women and a growing emphasis on multidisciplinary teams. Although Colombian funding for paleontological research remains very low, international funds and the expansion of global collaborative networks created by Colombian researchers appear to have helped sustain the growth of paleontological research despite reductions in national funding.

Data availability

The data supporting this study's findings are available in the Supplementary Information Dataset (**Jaramillo *et al.*, 2026**).

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Author Contributions

A.C. and C.J. established the methodology, coordinated the research, and led the writing of the manuscript. F.A. compiled the database. A.C. performed the data curation.

References

- Bolker, B.M., Brooks, M.E., Clark, C.J., Geange, S.W., Poulsen, J.R., Stevens, M.H., White, J.D.S.** (2009). Generalized linear mixed models: a practical guide for ecology and evolution. *Trends in Ecology and Evolution*, 24(3), 127-135. <https://doi.org/10.1016/j.tree.2008.10.008>
- Cadena, E.** (2015). The first South American sandownid turtle from the Lower Cretaceous of Colombia. *PeerJ*, 3, e1431. <https://doi.org/10.7717/peerj.1431>
- Cadena, E. A. & Parham, J. F.** (2015). Oldest known marine turtle? A new protostegid from the Lower Cretaceous of Colombia. *PaleoBios*, 32(1). <https://doi.org/10.5070/P9321028615>
- Cadena, E.A.** (2020). In situ SEM/EDS compositional characterization of osteocytes and blood vessels in fossil and extant turtles on untreated bone surfaces; different preservational pathways microns away. *PeerJ*, 8, E9833. <https://doi.org/10.7717/peerj.9833>
- Cárdenas, A., Giraldo, J. D., Monterrosa, D., Weber, M.** (2023). Fossil leaves, woods, gastropods, and a crocodile tooth: Is the Amagá Formation worth exploring? *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 47(185), 943-951. <https://doi.org/10.18257/raccefyn.1896>
- Carrillo, J. D., Jaramillo, C., Abadía, F., Aguilera, O., Alfonso-Rojas, A., Billet, G., Benites-Palomino, A., Cadena, E.-A., Cárdenas, A., Carlini, A.A., Carrillo-Briceño, J., Carvalho, M., Cortés, D., Escobar, J., Herrera, F., Link, A., Luque, J., Martínez, C., Pérez-Lara, D.K., Salas-Gismondi, R., ... & Zapata, S.** (2023). The Miocene La Venta Biome (Colombia): A century of research and future perspectives. *Geodiversitas*, 45(26), 739-767. <https://doi.org/10.5252/geodiversitas2023v45a26>
- Carvalho, M. R., Herrera, F. A., Jaramillo, C. A., Wing, S. L., Callejas, R.** (2011). Paleocene Malvaceae from northern South America and their biogeographical implications. *American Journal of Botany*, 98(8), 1337-1355. <https://doi.org/10.3732/ajb.1000539>
- Cortés, D. & Páramo-Fonseca, M. E.** (2018). Restos apendiculares de un ictiosaurio ofthalmosáurido del Barremiano inferior de Villa de Leiva, Colombia. *Boletín de Geología*, 40(1), 15-30. <https://doi.org/10.18273/revbol.v40nl-2018001>
- Cortés, D., Larsson, H. C., Maxwell, E. E., Ruge, M. L. P., Patarroyo, P., Wilson, J. A.** (2019). An early Cretaceous teleosauroid (Crocodylomorpha: Thalattosuchia) from Colombia. *Ameghiniana*, 56(5), 365-379. <https://doi.org/10.5710/AMGH.26.09.2019.3269>
- Cortés, D., Maxwell, E. E., Larsson, H. C.** (2021). Re-appearance of hypercarnivore ichthyosaurs in the Cretaceous with differentiated dentition: revision of 'Platypterygius' sachicarum (Reptilia: Ichthyosauria, Ophthalmosauridae) from Colombia. *Journal of Systematic Palaeontology*, 19(14), 969-1002. <https://doi.org/10.1080/14772019.2021.1989507>
- Cortés, D.** (2024). El impacto de las mujeres colombianas en la Paleontología. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 48(186), 216-221. https://doi.org/10.18257/raccefyn_2604
- Coxe, S., West, S. G., Aiken, L. S.** (2013). Generalized linear models. *The Oxford handbook of quantitative methods*, 2, 26-51. https://doi.org/10.18257/raccefyn_2604
- Cuatrecasas, J.** (1958). Aspectos de la vegetación natural de Colombia. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 10(40), 221-264.
- Etayo-Serna, F.** (1968). El Sistema Cretáceo en la región de Villa de Leiva y zonas próximas. *Geología Colombiana*, 5, 5-74.
- Etayo-Serna, F.** (1979). Zonation of the Cretaceous of central Colombia by ammonites. *Publicaciones Geológicas Especiales del Ingeominas*, 2, 1-186.

- García, Y., Rángel, J. O., Jaramillo, A.** (2022). Environmental changes during the last 1800 years in the Neguanje mangrove, Tayrona National Natural Park, Colombian Caribbean. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 46(178), 90-107. <https://doi.org/10.18257/raccefyn.1518>
- González-Orozco, C. E.** (2023). Unveiling evolutionary cradles and museums of flowering plants in a Neotropical biodiversity hotspot. *Royal Society Open Science*, 10(10), 230917. <https://doi.org/10.1098/rsos.230917>
- Herrera, F., Carvalho, M. R., Wing, S. L., Jaramillo, C., Herendeen, P. S.** (2019). Middle to Late Paleocene Leguminosae fruits and leaves from Colombia. *Australian Systematic Botany*, 32(6), 385-408. <https://doi.org/10.1071/SB19001>
- Hendy, A. J., Jones, D. S., Moreno, F., Zapata, V., Jaramillo, C.** (2015). Neogene molluscs, shallow marine paleoenvironments, and chronostratigraphy of the Guajira Peninsula, Colombia. *Swiss Journal of Palaeontology*, 134(1), 45-75. <https://doi.org/10.1007/s13358-015-0074-1>
- Jaramillo, C.** (2012). Historia geológica del bosque húmedo neotropical. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 36(138), 57-77.
- Jaramillo, C., Krigsfeld-Shuster, G. D., Rojas, C., Henao, A., Ojeda, G. Y., Caballero, D., Escobar-Florez, S., Gómez, S., Escobar, J.** (2022). Depósitos del Pleistoceno Superior en el Valle del Río Cauca. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 46(179), 482-495. <https://doi.org/10.18257/raccefyn.1666>
- Jaramillo, C., Cárdenas, A., Abadía, F.** (2026). Two centuries of Colombian Paleontology Dataset. *Smithsonian Research Data Repository*. <https://doi.org/10.60635/C3HD0Q>
- Kay, R.F., Madden, R. H., Cifelli, R. L., Flynn, J. J.** (1997). *Vertebrate paleontology in the neotropics: the Miocene fauna of La Venta, Colombia*. Smithsonian Institution Scholarly Press, Washington, DC.
- Luque, J., Feldmann, R. M., Vernygora, O., Schweitzer, C. E., Cameron, C. B., Kerr, K. A., Vega, F. J., Duque, A., Strange, A., Palmer, A. R., Jaramillo, C.** (2019). Exceptional preservation of mid-Cretaceous marine arthropods and the evolution of novel forms via heterochrony. *Science Advances*, 5(4), eaav3875. <https://doi.org/10.1126/sciadv.aav3875>
- Luque, J., Cortés, D., Rodríguez-Abaunza, A., Cárdenas, D., Parra, J. D.** (2020). Orithopsid crabs from the Lower Cretaceous Paja Formation in Boyacá (Colombia), and the earliest record of parasitic isopod traces in Raninoida. *Cretaceous Research*, 116, 104602. <https://doi.org/10.1016/j.cretres.2020.104602>
- Madden, R. H., Guerrero, J., Kay, R. F., Flynn, J. J., Swisher, C. C., III, Walton, A. H.** (1997). The Laventan Stage and Age. In R. F. Kay, R. H., Madden, R. L. Cifelli, & J. J. Flynn (Eds.), *Vertebrate Paleontology in the Neotropics: The Miocene Fauna of La Venta, Colombia* (pp. 499-519). Smithsonian Institution Press.
- Mantilla-Meluk, H., Vásquez-Palacios, S., Vargas-Arboleda, A. F., Montilla, S. O., Botero-Botero, A., Sánchez-Alzate, L. J., Muñoz-Garay, J. ., Ramírez-Chaves, H., González, A., Mosquera-Guerra, F., Zamora, A., Cuadrado-Ríos, S., Gómez-Montoya, F., Cuadrado-Ríos, S.** (2023). Los mamíferos del Quindío, Colombia. I. Reseña histórica sobre el desarrollo de la mastozoología. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 47(184), 520-540. <https://doi.org/10.18257/raccefyn.1776>
- Martínez, C., Jaramillo, C., Martínez-Murcia, J., Crepet, W., Cárdenas, A., Escobar, J., Moreno, F., Pardo-Trujillo, A., Caballero-Rodríguez, D.** (2021). Paleoclimatic and paleoecological reconstruction of a middle to late Eocene South American tropical dry forest. *Global and Planetary Change*, 205, 103617. <https://doi.org/10.1016/j.gloplacha.2021.103617>
- Mier-Restrepo, J.** (1930). Nota sobre un équido fósil de la Sabana de Bogotá. *Revista de la Sociedad Colombiana de Ciencias Naturales*, 106, 123-127.
- Mora-Rojas, L., Cárdenas, A., Jaramillo, C., Silvestro, D., Bayona, G., Zapata, S., Moreno, F., Silva, C., Moreno-Bernal, J.W., Jaramillo, J.S., Valencia, V., Ibáñez, M.** (2023). Stratigraphy of a middle Miocene neotropical lagerstätte (La Venta site, Colombia). *Geodiversitas*, 45(6), 197-221. <https://doi.org/10.5252/geodiversitas2023v45a6>
- Moreno, F., Hendy, A. J. W., Quiroz, L., Hoyos, N., Jones, D. S., Zapata, V., Zapata, S., Ballén, G. A., Cadena, E., Cárdenas, A. L., Carrillo-Briceño, J. D., Carrillo, J.D., Delgado-Sierra, D., Escobar, J., Martínez, J. I., Martínez, C., Montes, C., Moreno, J., Pérez, N., Sánchez, R., Suárez, C., Vallejo-Pareja, M.C., Jaramillo, C.** (2015). Revised stratigraphy of Neogene strata in the Cocinetas basin, La Guajira, Colombia. *Swiss Journal of Palaeontology*, 134(1), 5-43. <https://doi.org/10.1007/s13358-015-0071-4>
- Myers, N., Mittermeier, R. A., Mittermeier, C. G., Da Fonseca, G. A., Kent, J.** (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403(6772), 853-858. <https://doi.org/10.1038/35062>

- org/10.1038/35002501
- Palacios-Hurtado, C., González-Caro, S., Peña, M. A., Castaño, N., Barona-Colmenares, A., Cardona, F., David, H., Hoyos-Gómez, S.E., Idárraga-Piedrahita, Á., Llano-Almario, M., Martínez-Villa, J.A., Mosquera, H.Q., Sánchez, M., Duque, Á.** (2025). Patterns and Drivers of Tree Species Accumulation in Three Biodiversity Hotspots of Northwestern South America. *Journal of Biogeography*, 52(12), e70069. <https://doi.org/10.1111/jbi.70069>
- Páramo-Fonseca, M. E.** (2013). *Eonator coellensis* nov. sp. (Squamata: Mosasauridae), a new species from the Upper Cretaceous of Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 37(145), 499-518.
- Páramo-Fonseca, M. E., Benavides-Cabra, C. D., Gutiérrez, I. E.** (2018). A new large pliosaurid from the Barremian (Lower Cretaceous) of Sábica, Boyacá, Colombia. *Earth Sciences Research Journal*, 22(4), 223-238. <https://doi.org/10.15446/esrj.v22n4.69916>
- Pardo-Jaramillo, M.** (2010). Reporte de un nuevo ejemplar de *Granatapotherium snorki* en el Valle Superior del Magdalena, Desierto de la Tatacoa, Huila. Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 34(131), 253-256. <https://doi.org/10.18257/issn.0370-3908>
- Pardo-Jaramillo, M.** (2012). Reporte del hallazgo de un cráneo de *Stegostadon waringi* (Holland, 1920) juvenil (Mammalia, Proboscidea) en la zona del municipio de Turbaná, Bolívar. Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 36(139), 499-518.
- Pardo-Trujillo, A., Plata-Torres, A., Ramírez, E., Vallejo-Hincapié, F., Trejos-Tamayo, R.** (2023). Eocene to Miocene palynology of the Amagá basin (Cauca Valley, Colombia) compared to the Caribbean region. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 47(185), 925-942. <https://doi.org/10.18257/raccefyn.1921>
- Plata-Torres, A., Pardo-Trujillo, A., Gómez-González, C., Flores, J.A.** (2023). Paleopalynology in Colombia: A review. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 47(183), 412-438. <https://doi.org/10.18257/raccefyn.1913>
- Patarroyo, P.** (2000). Distribución de amonitas del Barremiano de la Formación Paja en el sector de Villa de Leyva (Boyacá, Colombia). Bioestratigrafía. *Geología Colombiana*, 25, 149-162.
- Pelegrin, J. S.** (2024). The first terror bird of Colombia: a giant rewriting the paleoecology and palaeobiogeography of La Venta Miocene. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 48(189), 963-966. <https://doi.org/10.18257/raccefyn.3120>
- Pérez-Escobar, O. A., Chomicki, G., Condamine, F. L., Karremans, A. P., Bogarín, D., Matzke, N. J., Silvestro, D., Antonelli, A.** (2017). Recent origin and rapid speciation of Neotropical orchids in the world's richest plant biodiversity hotspot. *New Phytologist*, 215(2), 891-905. <https://doi.org/10.1111/nph.14629>
- Pérez-Lara, D.K., Martínez, C., Pizano, C., Jaramillo, C., Vásquez, V.** (2024). A Late Holocene Lecythidaceae wood record from Valle del Cauca, Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 48(189), 922-935. <https://doi.org/10.18257/raccefyn.3085>
- R Core Team.** (2025). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>
- Rincón, A. F., Raad-Pájaro, D. A., Jiménez-Velandia, H. F., Ezcurra, M. D., Wilson-Mantilla, J. A.** (2022). A sauropod from the Lower Jurassic La Quinta Formation (Dept. Cesar, Colombia) and the initial diversification of eusauropods at low latitudes. *Journal of Vertebrate Paleontology*, 42(1), e2077112. <https://doi.org/10.1080/02724634.2021.2077112>
- Thenius, E. & Burgl, H.** (1957). Los mamíferos suramericanos en perspectiva histórica. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 10(39), 123-130.
- Valencia-Giraldo, Y. P., Escobar-Arenas, L. C., Mendoza-Ramírez, J., Delgado-Sierra, D., Cárdenas-Rozo, A. L.** (2016). Review of fossiliferous localities at Antioquia department, Colombia. *Boletín de Ciencias de la Tierra*, (40), 46-54. <https://dx.doi.org/10.15446/rbet.n40.53748>
- Villarroel, C.** (1998). Los Nothrotheriinae (Megatheriidae, Gravigrada) del Mioceno de La Venta (Colombia). Descripción de *Huilabradys magdalenensis*, nuevos género y especie. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 22(85), 497-506. [https://doi.org/10.18257/raccefyn.22\(85\).1998.2941](https://doi.org/10.18257/raccefyn.22(85).1998.2941)
- Villarroel, C.** (2000). Un nuevo mylodontinre (Xenarthra, Tardigrada) en la fauna de La Venta, Mioceno de Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y*

-
- Naturales*, 24(90), 117-127. [https://doi.org/10.18257/raccefyn.24\(90\).2000.2842](https://doi.org/10.18257/raccefyn.24(90).2000.2842)
- von Buch, L.** (1838). Über den zoologischen Charakter der Secundär-Formationen in Südamerika. *Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlischen Preussischen Akademie der Wissenschaften zu Berlin*, 54-67.
- Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L.D., Francois, R. Grolemond, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T.L., Miller, E., Bache, S.M., Müller, K., Ooms, J., Robinson, D., Paige Seidel, D., Spinu, V., Takahashi, K., Vaughan, D., Wilke, C., Woo, K., Yutani, H.** (2019). Welcome to the tidyverse. *Journal of Open Source Software*, 4(43), 1686. <https://doi.org/10.21105/joss.01686>
- Wuchty, S., Jones, B.F., Uzzi, B.** (2007). The increasing dominance of teams in production of knowledge. *Science*, 316(5827), 1036-1039. <https://doi.org/10.1126/science.1136099>