

Floristics in araucaria forests: a bibliometric approach

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ABSTRACT – This study conducted a bibliometric review on the subject of floristic surveys of the mixed ombrophilous forest, also known as araucaria Forest, investigating its scientific production and research trends over time. The research utilized the Scopus database (Elsevier). Data were analyzed using the VOSviewer software. A total of 118 documents published between 1981 and 2024 were found, distributed across 46 journals, focusing mainly on the proposed theme. Brazil led in the quantity of documents, followed by Germany and Argentina. The analysis of keywords and institutions revealed predominant themes such as forest fragmentation and natural regeneration, with emphasis on brazilian institutions like the Santa Catarina State University. The results highlight the growing interest in studies on araucaria forests, particularly in Brazil, and the relevance of brazilian institutions in producing this research. Despite the recent decrease in the number of studies, research remains crucial for understanding the biodiversity and conservation of these ecosystems.

Keywords: Mixed ombrophilous forest; Atlantic Forest; phytosociology; Scopus.

Florística em florestas de araucária: uma abordagem bibliométrica

RESUMO – Este estudo conduziu uma revisão bibliométrica sobre a temática de levantamentos florísticos da floresta ombrófila mista, também conhecida como floresta de araucária, investigando sua produção científica e tendências de pesquisa ao longo do tempo. A pesquisa utilizou a base de dados Scopus (Elsevier). Os dados foram analisados utilizando o software VOSviewer. Foram encontrados 118 documentos publicados entre 1981 e 2024, distribuídos em 46 periódicos, com foco principalmente no tema proposto. O Brasil liderou em quantidade de documentos, seguido pela Alemanha e Argentina. A análise das palavras-chave e instituições revelou temas predominantes como fragmentação florestal e regeneração natural, com destaque para instituições brasileiras como a Universidade do Estado de Santa Catarina. Os resultados ressaltam o crescente interesse em estudos sobre florestas de araucária, principalmente no Brasil, e a relevância das instituições brasileiras na produção dessas pesquisas. Apesar da recente diminuição no número de estudos, a pesquisa continua crucial para a compreensão da biodiversidade e conservação desses ecossistemas.

Palavras-chave: Floresta ombrófila mista; Mata Atlântica; fitossociologia; Scopus.

Florística en bosques de araucaria: un enfoque bibliométrico

RESUMEN – Este estudio realizó una revisión bibliométrica sobre el tema de los estudios florísticos del bosque ombrófilo mixto, también conocido como bosque de araucaria, investigando su producción científica y tendencias de investigación a lo largo del tiempo. La investigación utilizó la base de datos Scopus (Elsevier). Los datos fueron analizados utilizando el software VOSviewer. Se encontraron un total de 118 documentos publicados entre 1981 y 2024, distribuidos en 46 revistas, centrándose principalmente en el tema propuesto. Brasil lideró en la cantidad de documentos, seguido por Alemania y Argentina. El análisis de palabras clave e instituciones reveló temas predominantes como la fragmentación forestal y la regeneración natural, con énfasis en instituciones brasileñas como la Universidad del Estado de Santa Catarina. Los resultados resaltan el creciente interés en estudios sobre los Bosques de Araucaria, especialmente en Brasil, y la relevancia de las instituciones brasileñas en la producción de esta investigación. A pesar de la reciente disminución en el número de estudios, la investigación sigue siendo crucial para comprender la biodiversidad y conservación de estos ecosistemas.

Palabras clave: Bosque ombrófilo mixto; Bosque Atlántico; fitosociología; Scopus.

Introduction

The mixed ombrophilous forest (MOF) is an ecosystem found mainly in the southern region of Brazil. In this country, it covers parts of the states of Paraná, Santa Catarina and Rio Grande do Sul, and extends into other territories, being present in eastern Paraguay and northeastern Argentina [1]. It is one of the main forest typologies found in the Atlantic Forest, being considered a *hotspot* of biodiversity [2]. Furthermore, it is a socio ecological system, with human and ecosystem interactions, promoting their interdependence and population resilience [3].

This ecosystem is mainly characterized by the presence of *Araucaria angustifolia* (Bertol) Kuntze, commonly known as Araucária – thus the name “araucaria forest”. It has substantial economical, social, cultural and ecological importance [4], whereas it provides food for both fauna and humans in periods of shortage, assuring food security [5]. Inside the forest system, it is the main dominant species, forming clusters in association with other species at different successional stages [6]. Under their canopy, *A. angustifolia* trees shelter a high diversity of species of trees, forming three well-defined strata. The upper one, composed of large trees, the lower one, occupied by smaller ones, and, in the middle, the shrub-herbaceous stratum [7]. However, the abundance and size of these strata may vary according to the climatic conditions [8], geographic location and the community developmental stage [9].

Unfortunately, the araucaria forest was severely deforested in the past, causing high levels of fragmentation, forming small forest clusters [10]. Due to this depletion and dependency, the development of projects aiming at recovery and/or restoration of this forest typology are crucial. In this context, various techniques may be used for this purpose, from isolating the site, enabling natural regeneration, to human interventions in order to increase species richness, accelerating forest growth and restoring ecological activities [11] [12].

Moreover, the monitoring of the degraded areas is of high importance, because, depending on the stress level, the site may or may not be capable of natural regeneration. For comparative purposes and evaluations, results can be obtained from other studies conducted in the same region or with the same forest characteristics. These can provide information on species diversity, richness, phytosociology, floristics and tree growth [13] [14]. To precisely develop a forest restoration project for the araucaria forest, knowing their floristics and phytosociology is fundamental. In this way, the objective of this study was to map scientific production on the topic, highlighting the most influential authors, journals, and institutions published on the Scopus platform, and to reveal gaps for future research in this ecosystem.

Material and Method

To conduct the bibliometric review, the Scopus database (Elsevier) was utilized, this database was chosen because it is considered to offer the largest collection of peer-reviewed scientific publications, in addition to its constant improvement and presence of scientific quality research [15] [16] [17]. The search strategy was crafted using the “Title-Abstracts-Keywords” option. There, the checked terms were: “araucaria forest” OR “mixed ombrophilous forest” OR “FOM” (floresta ombrófila mista) AND “floristic*” OR “phytosociology”. Inclusion criteria were set to select papers published in journals without language restrictions, and to widen the scope of the research, no filters were applied.

Articles published in scientific journals were included, with no language restrictions. The time frame covered the entire period available in the database, from 1981 to April 2024, in order to encompass all scientific production on the subject recorded in Scopus. Afterwards, the following data was recorded: journals with the highest publication volume, the most influential authors in the field, the most active research institutions, frequently cited keywords, citations by country and areas of interest. This information was exported into “comma-separated-values” (CSV) format. Subsequently, the resulting dataset underwent evaluation using the VOSviewer software [18] [19] [20], facilitating the creation of bibliometric networks, diagrams, and data exploration maps.

Thus, this study is characterised as descriptive, quantitative and exploratory research, conducted through a bibliometric review. The quantitative approach is justified by the analysis of bibliometric indicators, while the descriptive and exploratory nature stems from the intention to map, synthesise and identify trends and gaps in scientific production on the mixed rainforest.

Results and Discussion

The bibliometric search on the Scopus platform yielded a total of 118 documents, dated between 1981 and 2024. An average of 2.7 articles published per year. These papers were published in 46 journals, sharing 42 interconnections. The journals and their respective links are illustrated in Figure 1. The proximity between the journals reflects how often they present co-citation in the documents analyzed, as well as the dark blue colors represent the journals with more recent publications.

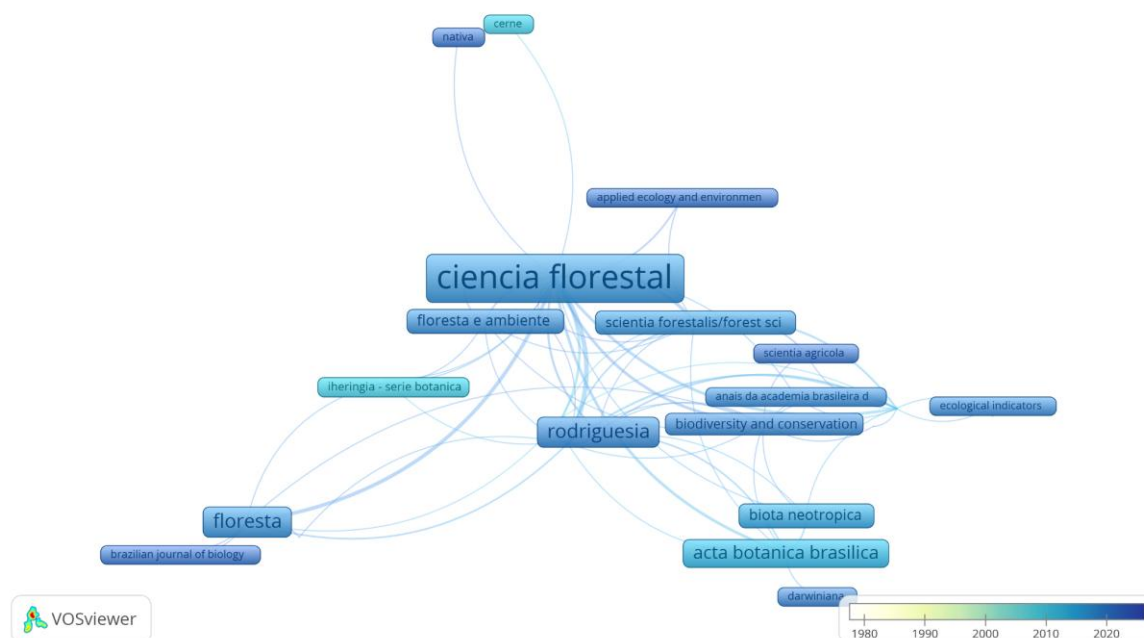


Figure 1 – Journals associated with all documents published in *Scopus* until April 17, 2024. Source: Authors (2024).

It is noteworthy that the journals *Ciência Florestal*, *Revista Floresta*, and *Rodriguésia* exhibited a predominance of co-citations related to floristics in araucaria forests. It's worth mentioning that the first two journals are published by universities in the southern region of Brazil, thus receiving a significant number of submissions focused on regional flora.

The first paper on this topic was published in 1981, titled "Vegetation und ökologie eines Sphagnum-Moores in Südbrasilien" by Pfadenhauer J. The number of publications in the period ranging from 1981 to 2005 were scarce, but an increase was noted starting from 2006, peaking in 2019 with 16 articles on this topic. The last paper within the topic was published on April 17, 2024. This indicates a decrease in research production on the subject over this period. This decline in the number of publications could be the result of various factors, such as changes in research agendas, fluctuations in available funding resources, or even a temporary saturation of the field [21]. On the other hand, it is important to note that the quantity of publications does not necessarily reflect the relevance or importance of the topic, and there may be other indicators to consider, such as the quality and impact of the research conducted [22]. This goal can be achieved through funding agencies, directing resources to innovative lines of research, such as long-term studies in conservation, applied ecological restoration, and interdisciplinary research [23].

According to the bibliometric search, the author with the highest number of publications on the topic is Higuchi P., from Universidade do Estado de Santa Catarina, with a total of 29 papers, 497 citations, and 227 connections with other studies (Fig. 2). The lines in the co-citation network indicate the connections between authors, reflecting the strength of interaction among them. Therefore, more prominent lines and terms closer to each other indicate stronger associations. It is noticeable that the names of authors are arranged along the years, with colorations indicated in the legend. Thus, authors with more recent publications are represented by darker blue colors, and the frequency with which the author publishes on the topic is related to the larger areas of the frames.

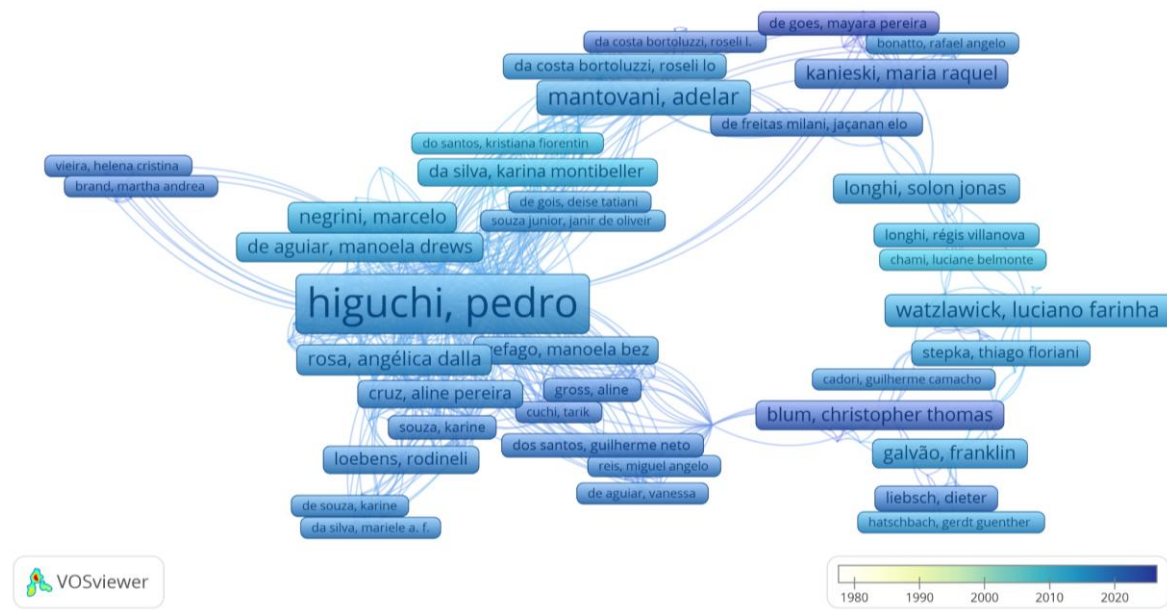


Figure 2 – Authors associated with all documents published in Scopus until April 17, 2024. Source: Authors (2024).

When considering a minimum of one document and one citation, citations were made from nine countries, with Brazil leading the number of publications with 144 documents, followed by Germany and Argentina with 3

documents each (Fig. 3). The documents from Brazil have 1354 citations and connections with 7 countries. Brazil's predominance in terms of the quantity of documents (96%) published highlights that the country's geographical location, hosting the majority of araucaria forests [7], is the primary factor driving research on its flora. However, 54% of the articles found were written in English, demonstrating the internationalization and global reach of research on this ecosystem, especially in recent years.

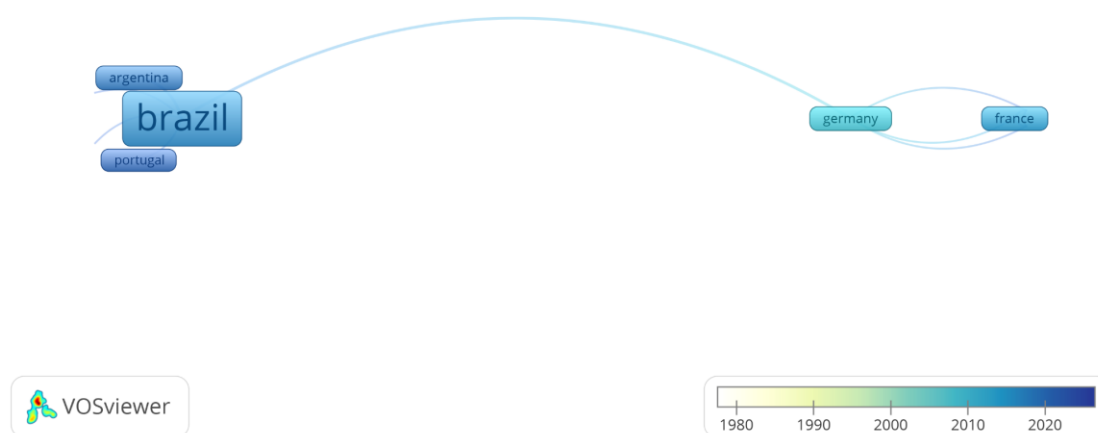


Figure 3 – Countries associated with all documents published in Scopus until April 17, 2024. Source: Authors (2024).

The search for total keywords per document generated 625 terms, with "araucaria forest" occurring in 56 documents, "araucaria" in 47, and "phytosociology" in 22 documents (Fig. 4A). On the other hand, keywords indexed by authors per document generated 308 terms, with "araucaria forest" also occurring in 56 documents, "phytosociology" in 20, and "Atlantic Forest" in 14 documents (Fig. 4B). It is important to note that the same document may have addressed more than one keyword in both surveys.



B

The institutions linked (organizations) per document and 1 citation per document generated 267 citations and 249 connections. The Universidade do Estado de Santa Catarina is the institution associated with the highest number of documents, with 41 publications distributed among its various undergraduate and graduate programs, followed by the Universidade Federal do Paraná and the Universidade Regional de Blumenau (Fig. 5). In this case, these Brazilian institutions have researchers with specific experience and interest in the uses of the Araucaria forest, and they are located in regions where this ecosystem is predominant or holds

significant biodiversity importance. Proximity to local organizations such as natural parks, reserves, and research institutes may also be a key factor in research development and collaborations.

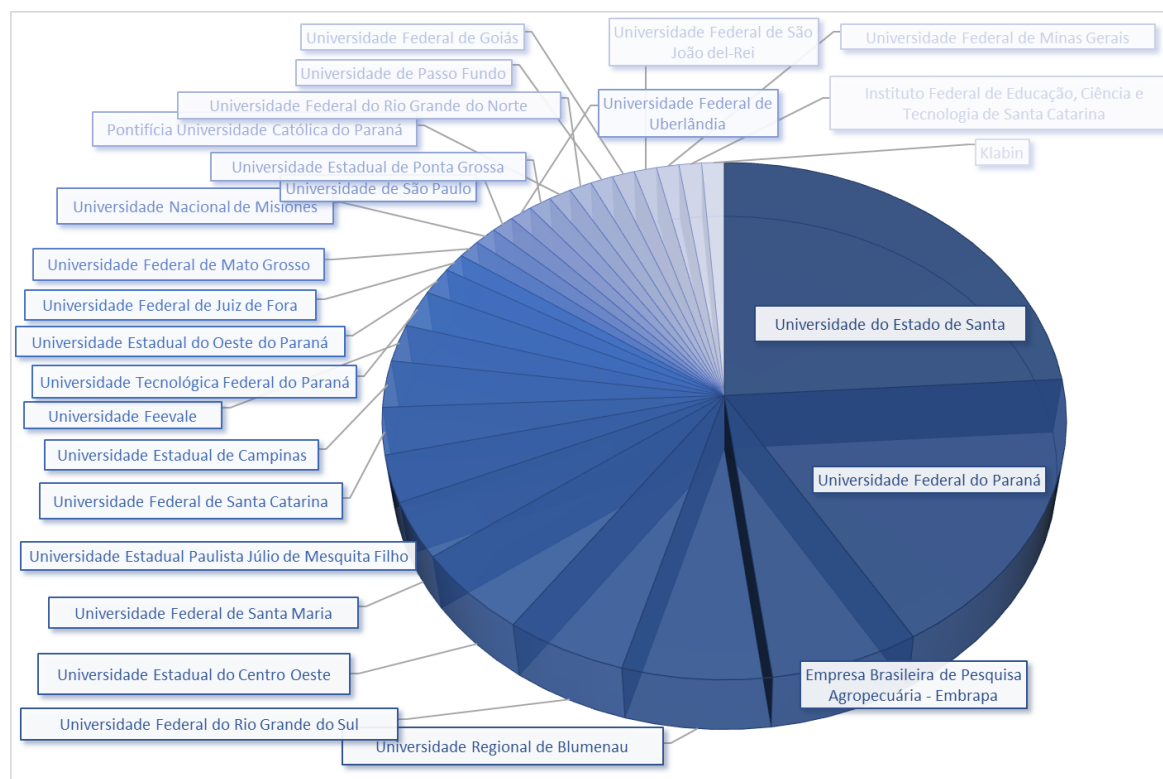


Figure 5 – Institutions associated with all documents published in Scopus until April 17, 2024. Source: Authors (2024).

There was a variation in areas of interest according to the *Scopus* classification during the analyzed period. The main areas of science from indexed articles on the topic are displayed in Figure 6. According to the data collected, 73.5% of the documents belong to the field of Agricultural and Biological Sciences, with 111 publications, followed by Environmental Science, with 28 documents (18.5%), and Decision Sciences, with only 2 documents (1.3%).

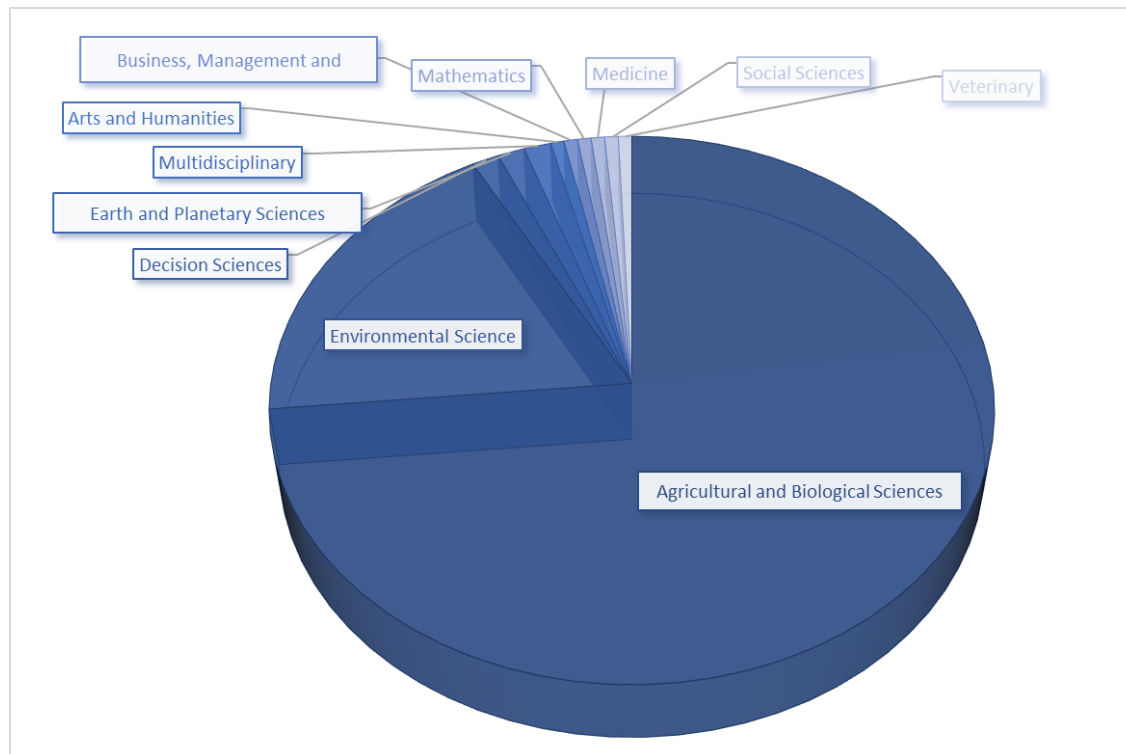


Figure 6 – Areas of interest of documents published in Scopus until April 17, 2024. Source: Authors (2024).

The flora of the araucaria forest is an important part of biodiversity and natural ecosystems, hence falling within the scope of agricultural and biological sciences. Studies on the composition, distribution, ecology, and conservation of plant species in these forests largely occupy research in these areas. Additionally, these ecosystems are sensitive to threats such as deforestation, fragmentation, and climate change, closely related to environmental sciences.

The bibliometric analysis indicated that although surveys on the composition and floristic structure of the araucaria forest exist, fragmentation poses a barrier to conducting comprehensive and robust floristic surveys [14]. Notable exceptions to this challenge are large-scale state-sponsored initiatives, such as the Floristic and Forest Inventory of Santa Catarina (IFFSC), which successfully conducted a systematic and comprehensive survey across the entire state, including its significant portions of araucaria forest [26].

This is particularly relevant due to the importance of conserving the Atlantic Forest biome and its various ecosystems [27]. The scarcity of comparative bibliometric surveys with other Brazilian phytoecological formations underscores the need for a more comprehensive and integrated approach in research on Brazilian forests overall. Therefore, there is a need for studies that investigate the dynamics of Brazilian forests.

Nevertheless, the searches found highlight Brazil as the main country of origin of the publications, reflecting its rich biodiversity and the importance of araucaria forests within its territory. The predominance of Brazilian institutions in the production of these studies, notably those located in the region covered by the biome, such as the University of Estado de Santa Catarina (UDESC), underscores the crucial role of institutions in conducting research on this topic. For the scientific community, the urgency of strengthening national and international collaborative networks and carrying out comparative studies with other biomes or forest formations is highlighted. For public managers and environmental agencies, this mapping can help guide conservation and restoration policies specific to this unique ecosystem [23].

Conclusion

This bibliometric analysis reveals a growing interest in studies on the araucaria forest, especially in Brazil. The main patterns identified include a predominance of Brazilian institutions concentrated in a small number of authors. Most of the publications are focused on the areas of Agricultural and Biological Sciences, underlining the ecological and floristic focus of the research, while areas such as Environmental Sciences and, especially, disciplines applied to conservation policy and economics, remain underrepresented. Despite the decline in floristic studies in recent years, recent research remains crucial for understanding the biodiversity and conservation of araucaria forest.

It is important to recognize as a limitation of this study the exclusive use of the Scopus database. Although it is a comprehensive and prestigious platform, it is recommended that future bibliometric reviews may include other databases, such as Web of Science, SciELO, and Dimensions, to capture a broader spectrum of literature, particularly from regional and open access journals.

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References

1. Filho AF, Dias AN, Stepka TF, Sawczuk, AR. Crescimento, mortalidade, ingresso e distribuição diamétrica em Floresta Ombrófila Mista. *Floresta*. 2010; 40: 763-776. <http://dx.doi.org/10.5380/rf.v40i4.20328>
2. Neves DM, Dexter KG, Pennington RT, Valente ASM, Bueno ML, Eisenlohr PV, et al. Dissecting a biodiversity hotspot: the importance of environmentally marginal habitats in the Atlantic Forest Domain of South America. *Diversity and Distributions*. 2017; 23: 898–909. doi: <https://doi.org/10.1111/ddi.12581>
3. Folke C, Carpenter SR, Walker B, Scheffer M, Chapin T, Rockström J. Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and society*. 2010; 15(4).
4. Tagliari MM, Levis C, Flores BM, Blanco GD, Freitas CT, Bogoni JA, et al. Collaborative management as a way to enhance araucaria forest resilience. *Perspect. Ecol. Conserv.* 2021; 19: 131–142. doi: <https://doi.org/10.1016/j.pecon.2021.03.002>
5. Bogoni JA, Muniz-Tagliari MM, Peroni N, Peres CA. Testing the keystone plant resource role of a flagship subtropical tree species (*Araucaria angustifolia*) in the Brazilian Atlantic Forest. *Ecol. Indic.* 2020; 118: 106778. doi: <https://doi.org/10.1016/j.ecolind.2020.106778>
6. Vibrans AC, Sevegnani L, Uhlmann A, Schorn LA, Sobral MG, Gasper AL, et al. Structure of mixed ombrophylous forests with *Araucaria angustifolia* (Araucariaceae) under external stress in Southern Brazil. *Revista de Biologia Tropical*. 2011; 59(3): 1371-1387.
7. Klein RM. O aspecto dinâmico do pinheiro brasileiro. *Sellowia* 1960; 12(12): 17-51.
8. Saraiva DD, Esser LF, Grasel D, Jarenkow JA. Distribution shifts, potential refugia, and the performance of protected areas under climate change in the Araucaria moist forests ecoregion. *Applied Vegetation Science*. 2021; 24: e12628. doi: <https://doi.org/10.1111/avsc.12628>
9. Martins D, Chaves CL, Bortoluzzi RCL, Mantovani A. Florística de Floresta Ombrófila Mista Alto-Montana e de Campos em Urupema, Santa Catarina, Brasil. *Revista Brasileira de Biociências*. 2011; 9(2).
10. Carlucci MB, Marcilio-Silva V, Torezan JMD. The southern Atlantic Forest: use, degradation, and perspectives for conservation. In: Marques, M.C.M., Grelle, C.E.V. (Eds.), *The Atlantic Forest*. Springer, Cham. 2021. doi: https://doi.org/10.1007/978-3-030-55322-7_5
11. Turmina E, Kanieski MR, Silva AC, Higuchi P, Farias KJ, dos Santos GN. Regeneração natural de uma área de floresta ombrófila mista. *Oecologia Australis*. 2020; 24(1). doi: <https://doi.org/10.4257/oeco.2020.2401.07>

12. Erbaugh JT, Pradhan N, Adams J, Oldekop JA, Agrawal A, Brockington D, et al. Global forest restoration and the importance of prioritizing local communities. *Nature Ecology & Evolution*. 2020; 4(11): 1472-1476. doi: <https://doi.org/10.1038/s41559-020-01282-2>
13. Silva JOD, Silva ACD, Higuchi P, Mafra AL, Goncalves DA, Buzzi Junior F, et al. Floristic composition and phytogeography contextualization of the natural regeneration of an Alluvial Forest located in the "Planalto Sul Catarinense" Region, SC, Brazil. *Revista Árvore*. 2017; 41: e410203. doi: <https://doi.org/10.1590/1806-90882017000200003>
14. Passos MGD, Prado GPD, Fontana C, Bianchini E. Structure and tree diversity in a Mixed Ombrophilous Forest remnant, southern Brazil. *Floresta e Ambiente*. 2021; 28: e20200064. <https://doi.org/10.1590/2179-8087-FLORAM-2020-0064>
15. Khudzari JM, Kurian J, Tartakovsky B, Raghavan GV. Bibliometric analysis of global research trends on microbial fuel cells using Scopus database. *Biochemical engineering journal*. 2018; 136: 51-60. doi: <https://doi.org/10.1016/j.bej.2018.05.002>
16. Misra DP, Patro P. (2020). Registering and reporting systematic reviews. *Central Asian Journal of Medical Hypotheses and Ethics*. 2020; 1(2): 122-126. doi: <https://doi.org/10.47316/cajmhe.2020.1.2.03>
17. Gasparyan AY, Kitas GD. Editorial strategy to get a scholarly journal indexed by Scopus. *Mediterranean Journal of Rheumatology*. 2021; 32(1): 1-2. doi: <https://doi.org/10.31138/mjr.32.1.1>
18. Van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*. 2010; 84: 523-538. doi: <https://doi.org/10.1007/s11192-009-0146-3>
19. Ortigueira-Sánchez LC, Risco-Martínez SL. Visualizing the Scientific Landscape on Sustainable Consumption Research in Web of Science. *Responsibility and Sustainability*. 2023; 8(1): 42-51. doi: <https://doi.org/10.5281/zenodo.7539476>
20. VOSviewer - Visualizing scientific landscapes. Disponível em: <https://www.vosviewer.com/>.
21. Guerra A, Reis LK, Borges FLG, Ojeda PTA, Pineda DAM, Miranda CO, et al. (2020). Ecological restoration in Brazilian biomes: Identifying advances and gaps. *Forest ecology and Management*. 2020; 458, 117802. doi: <https://doi.org/10.1016/j.foreco.2019.117802>
22. Stremersch S, Verniers I, Verhoef PC. The quest for citations: Drivers of article impact. *Journal of Marketing*. 2007; 71(3): 171-193. doi: <https://doi.org/10.1509/jmkg.71.3.171>
23. Freitas JL, Caballero Rivero A, Sobral NV, Santos RNM dos, Silva FM. Research on the Brazilian Atlantic Forest (1989-2021): bibliometric and scientometric analysis. *AtoZ: New practices in information and knowledge*. 2024; 13, 1-15. doi: <https://doi.org/10.5380/atoz.v13i0.92074>
24. SOS Mata Atlântica. Atlas dos remanescentes florestais da Mata Atlântica: período 2015-2016. Technical report. 2017.
25. Schneider LCA, Silva MTD, Agostinetto L, Siegloch AE. Deforestation in Mixed Ombrophilous Forest in the serrana region of Santa Catarina. *Revista Árvore*. 2018; 42: e420206. doi: <https://doi.org/10.1590/1806-90882018000200006>
26. Gasper ALD, Sevegnani L, Vibrans AC, Sobral M, Uhlmann A, Lingner DV et al. Inventário florístico florestal de Santa Catarina: espécies da floresta ombrófila mista. *Rodriguésia*. 2013; 64: 201-210. doi: <https://doi.org/10.1590/S2175-78602013000200001>
27. Ribeiro MC, Metzger JP, Martensen AC, Ponzoni FJ, Hirota MM. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. *Biological conservation*. 2009; 142(6): 1141-1153. doi: <https://doi.org/10.1016/j.biocon.2009.02.021>

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