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Global research trends in biodiversity conservation strategies: A bibliometric analysis

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ABSTRACT

This study presents a bibliometric analysis of biodiversity conservation efforts to identify key research trends, themes, and gaps. Using the Scopus database with VOSviewer and RStudio, we analyzed publication trends, co-authorship networks, keyword co-occurrence, and citation patterns. The results reveal a significant surge in publications since 2019, peaking in 2022 and reflecting heightened global focus. The research is highly interdisciplinary, dominated by environmental sciences (35.9%) and agricultural and biological sciences (10.6%). Journals such as *Biodiversity and Conservation* and *Biological Conservation* serve as key publication venues. Geographically, Australia, India, and the United States lead in research output, with significant contributions from China and Brazil. Thematic analysis highlights strategic methodologies, ecosystem services, and conservation management as primary research drivers. This study underscores the necessity of international collaboration and interdisciplinary approaches for effective conservation. The insights provide a foundation for future research and offer strategic direction for academics and policymakers to enhance global biodiversity conservation initiatives.

Conflict of interest: The authors declare that they have no conflicts of interest.

Introduction

Biodiversity, the diversity of life forms on Earth, is crucial for the health and resilience of ecosystems[1–4]. Biodiversity enhances ecosystem services, which are vital for human survival. The decline of biodiversity is a critical environmental challenge confronting civilization today[5,6]. The reduction in species variety undermines ecosystems and jeopardizes the stability of human societies. The pressure on natural ecosystems is escalating due to

anthropogenic activities such as urbanization, deforestation, pollution, and climate change, hence intensifying the necessity for effective conservation techniques[7–9].

Conservation techniques typically focus on emphasizing the protection of ecosystems, the preservation of species, and the promotion of sustainable resource utilization[8,10,11]. Habitat conservation is crucial for sustaining ecological equilibrium, as habitats serve as the foundation for several species. Safeguarding these habitats requires environments necessitates a collaborative endeavor from all stakeholders[9,12].

Conducting a bibliometric analysis of diverse research and publications on biodiversity conservation measures is crucial, as it facilitates the discovery of patterns, trends, and advancements in the field comprehensively. Bibliometric analysis enables the identification of prevalent subjects, contributions from prominent academics or institutions, and international cooperation within this domain[13–18]. This technique also uncovers unexploited research gaps and prospective breakthroughs that could enhance biodiversity conservation initiatives. The discoveries facilitate data-driven decision-making and expedite the dissemination of interdisciplinary information to tackle global concerns, including climate change and habitat degradation.

Bibliometric analysis concentrating on biodiversity conservation strategies is still rather uncommon. An examination of the Scopus database indicates that between 1996 and 2024, only 10 review publications have explored this issue [9,19–27]. However, none have employed bibliometric analysis or a systematic literature review methodology. This underscores a notable deficiency in charting and integrating the comprehensive intellectual framework of biodiversity conservation initiatives. A bibliometric method is essential since it systematically identifies significant research trends, prominent authors, institutional collaborations, and topic developments throughout time, offering a structured comprehension of the global evolution of conservation techniques. This study adopts a holistic approach to biodiversity conservation, contrasting with prior bibliometric studies that typically concentrate on specialized subfields, such as protected areas, species conservation, or ecosystem management. This work addresses the gap, thereby improving understanding of current research trends and providing insights to facilitate future interdisciplinary collaboration and policy development.

This study aims to perform a thorough bibliometric analysis of biodiversity conservation strategy research to find trends, topics, and significant gaps in the current literature. This study seeks to examine publishing trends and collaboration networks among authors, institutions, and nations to elucidate the global landscape of biodiversity conservation strategy research.

This work significantly contributes to delineating the field of biodiversity conservation strategy research by a through bibliometric study. This article provides comprehensive insights into the evolution of literature in this field by addressing research questions related to temporal trends, primary areas of study, highly cited articles, pertinent publication sources, national leadership, international collaborations, institutional activities, and prevailing keyword patterns[28–31]. This analysis identifies strategic themes and predominant research areas while also uncovering research gaps that may serve as a foundation for future research advancements This paper is anticipated to serve as a significant reference for researchers, policymakers, and practitioners to comprehend the trajectory of biodiversity conservation science worldwide and enhance joint initiatives in addressing intricate ecological difficulties.

Method

Research framework

This study represents a bibliometric analysis. Bibliometric analysis is a form of library research employed to ascertain publication patterns within a certain topic of interest to the researcher. Bibliometric analysis is a quantitative approach for examining bibliographic data

within journal databases, specifically Scopus[32–37]. This methodology is employed to examine citations of publications referenced in a journal, delineate the scientific domain of a journal, and categorize scientific articles aligned with a research field.

Research Question (RQ)

This research aims to align with the study's objectives and systematically organize findings on biodiversity conservation measures through the following questions:

Temporal Trends in Publication RQ 1: What are the temporal trends and growth rates of publications concerning biodiversity conservation initiatives during the past few decades?

Research Domains and Principal Themes RQ 2: Which subject areas are most commonly investigated by researchers as fundamental components in the examination of conservation biodiversity strategies? RQ 8: What theme trends are discernible in the literature about biodiversity conservation strategies?Preeminent Publications and Influential References RQ 3: Which articles are the most quoted both internationally and locally in the domain of biodiversity conservation strategies?RQ 4: Which journals or publications are deemed most pertinent for research on biodiversity conservation strategies?

Geospatial Patterns and Cooperative Networks RQ 5: Which nations are at the forefront of publishing research on biodiversity conservation techniques, and what is the structure of collaboration among these nations? RQ 6: Which institutions are the most engaged or invested in financing research and publications pertaining to conservation biodiversity strategies?

Keyword Analysis and Emerging Research Trends RQ 7: What are the prevalent terms in the literature regarding biodiversity conservation strategies, and how do they signify contemporary research trends?

Search article and inclusion criteria

Although several studies have examined specific facets of biodiversity protection, thorough bibliometric evaluations in this field are still rather limited. Current research frequently emphasizes case studies or particular conservation techniques, neglecting to adequately delineate the wider philosophical framework. This study utilizes a bibliometric technique to discover significant trends, research deficiencies, and collaborative networks across authors, institutions, and nations. This report presents a structured overview of global research patterns, offering useful insights for informing future transdisciplinary initiatives and improving strategic decision-making in biodiversity conservation.

The search concentrated on the phrase “Strategy Conservation Biodiversity” across “all fields”, yielding 1.203 items. This search was excessively broad, yielding a considerable number of articles. Consequently, the search parameters were modified to include only “title, abstracts, and keywords,” resulting in a much reduced yield of 156 articles (publication status from 1991 to 2024). The inquiry was conducted utilizing the official subscription account held by Universitas Muhammadiyah Malang. Data simulation employs the "Analyze search results" feature accessible within the Scopus system. To enhance data and analysis, the data was exported to *CSV format (for visualizing the data process using VOSviewer and RStudio) and *RIS (for synchronization with Reference Manager [Mendeley]). The search history in Scopus is detailed below :TITLE (strategy AND + AND conservation AND + AND biodiversity) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT TO (LANGUAGE, "English")) AND (EXCLUDE (EXACTKEYWORD, "Article") OR EXCLUDE (EXACTKEYWORD, "StrategicApproach") OR EXCLUDE (EXACTKEYWORD, "Landscape") OR EXCLUDE (EXACTKEYWORD, "SustainableDevelopment") OR EXCLUDE (EXACTKEYWORD, "Nonhuman") OR EXCLUDE (EXACTKEYWORD, "LandUse") OR EXCLUDE (EXACTKEYWORD, "Stakeholder") OR EXCLUDE (EXACTKEYWORD, "SouthAfrica") OR EXCLUDE (EXACTKEYWORD, "China") OR EXCLUDE (EXACTKEYWORD, "DecisionMaking") OR EXCLUDE (EXACTKEYWORD, "Connectivity") OR EXCLUDE (EXACTKEYWORD, "UnitedStates") OR EXCLUDE (EXAC

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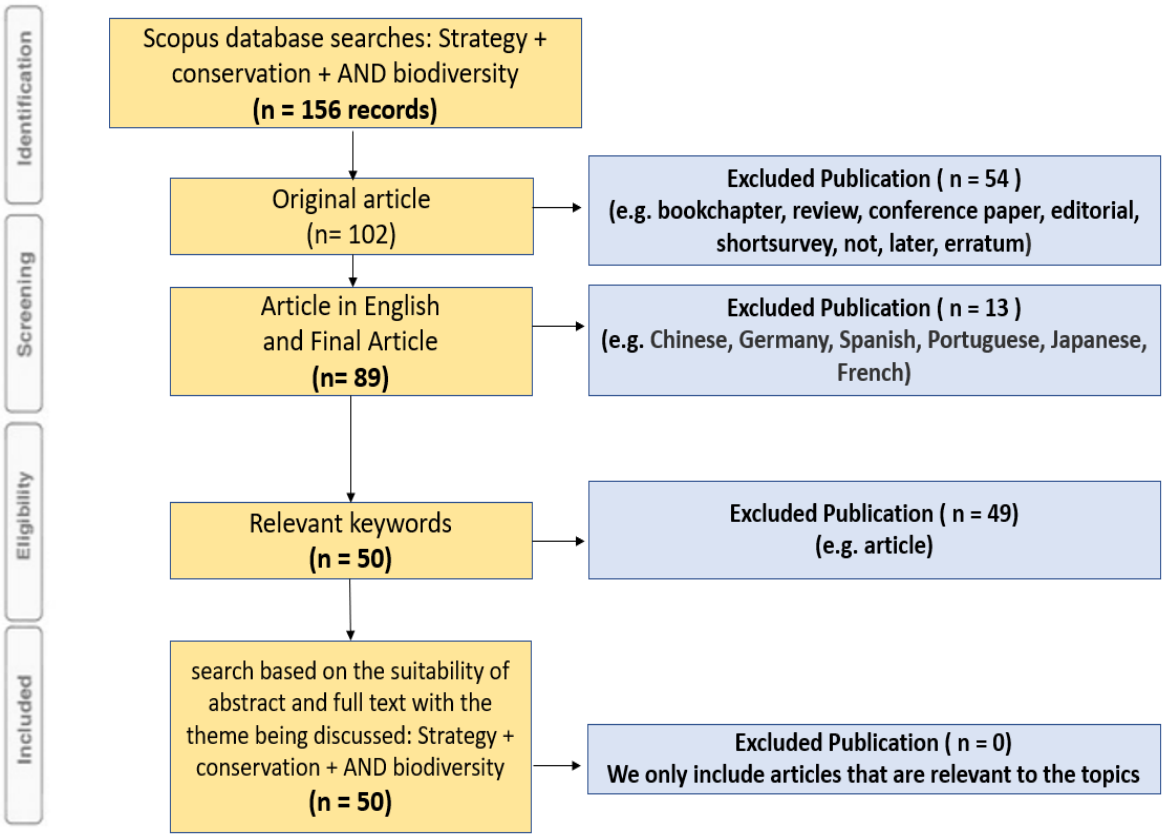

Fig. 1 | PRISMA flow diagram

Results and Discussion

Temporal distribution

Fig. 2 illustrates the annual count of documents pertaining to "Conservation Biodiversity" within the Scopus database. The chart indicates that the volume of publications on this subject was consistently low and stable from 1994 until about 2018, with only a limited number of documents produced each year. Beginning in 2019, there was a notable rise in the quantity of published documents. The apex transpired in 2022 and persisted with a comparatively elevated count until 2024.

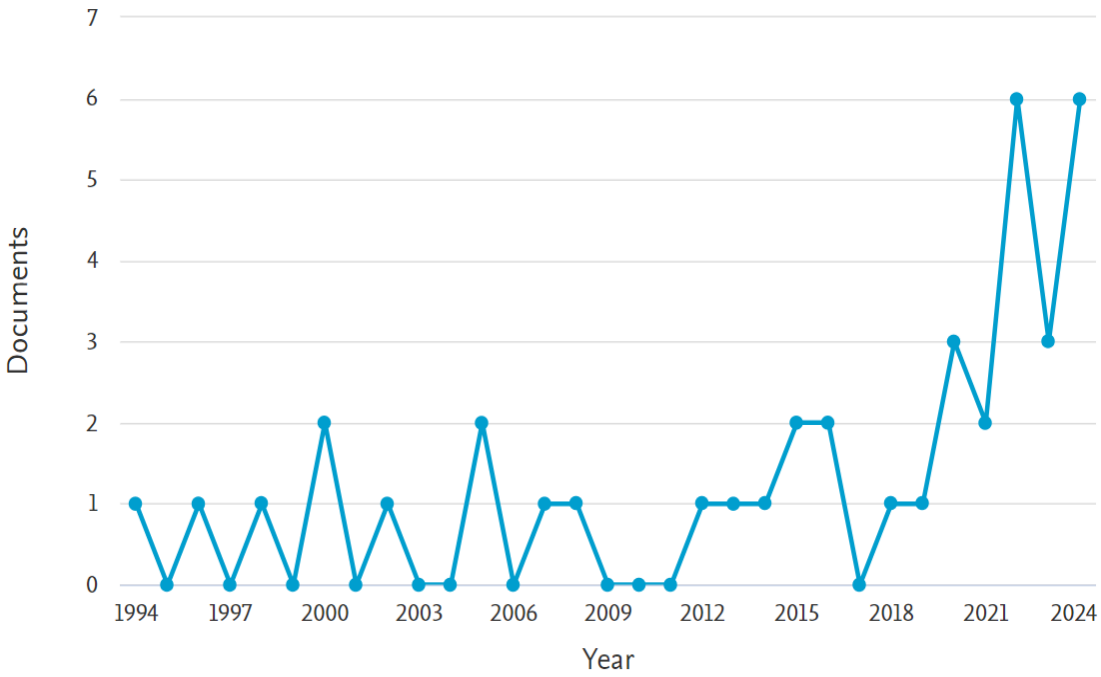

Fig. 2 | Documents by year

Publications about "biodiversity conservation strategy" have exhibited a notable increase since 2019, as evidenced by the graphical data from 1994 to about 2018, the volume of publications in this domain remained consistently low, with just a limited number of documents released each year. In 2022, a significant increase was observed, presumably fueled by heightened worldwide knowledge on the criticality of biodiversity conservation for ecological and environmental sustainability. This corresponds with the essential function of biodiversity in sustaining life on earth, particularly in addressing problems such as climate change, habitat destruction, and increasing environmental degradation[39,40].

With the growing global focus on environmental concerns, scientists and conservation professionals are increasingly investigating more effective methods for the preservation and restoration of biodiversity. Numerous studies indicate that community-based approaches and local involvement in conservation initiatives are essential for the success of conservation programs[41,42]. The expansion of technology and monitoring technologies has facilitated research in this sector, allowing scientists to comprehend ecosystem changes in real-time[43,44]. The reduction in publishing numbers in 2023 and 2024, as illustrated in the graph, may be attributable to many sources. One possibility is that many prior studies have addressed numerous facets of this issue, so restricting opportunities for further investigation. The difficult economic and social conditions during these years may have impacted research goals and financing in the conservation sector[45–47]. Nonetheless, it cannot be inferred that interest in this subject has diminished overall, as this research exclusively encompasses original articles, while numerous publications on conservation may be found in conference proceedings, books, reviews, and other formats.

Subject area

Fig. 3 illustrates the percentage distribution of subject categories for documents published in Scopus. The field with the most significant contribution is environmental science at 35.9%, succeeded by agricultural and biological sciences at 10.6%. Additional fields encompass biochemistry, genetics, and molecular biology (4.7%), social sciences (4.7%), engineering (3.1%), and earth and planetary sciences (3.1%). Multidisciplinary studies and decision sciences each provide 1.6%.

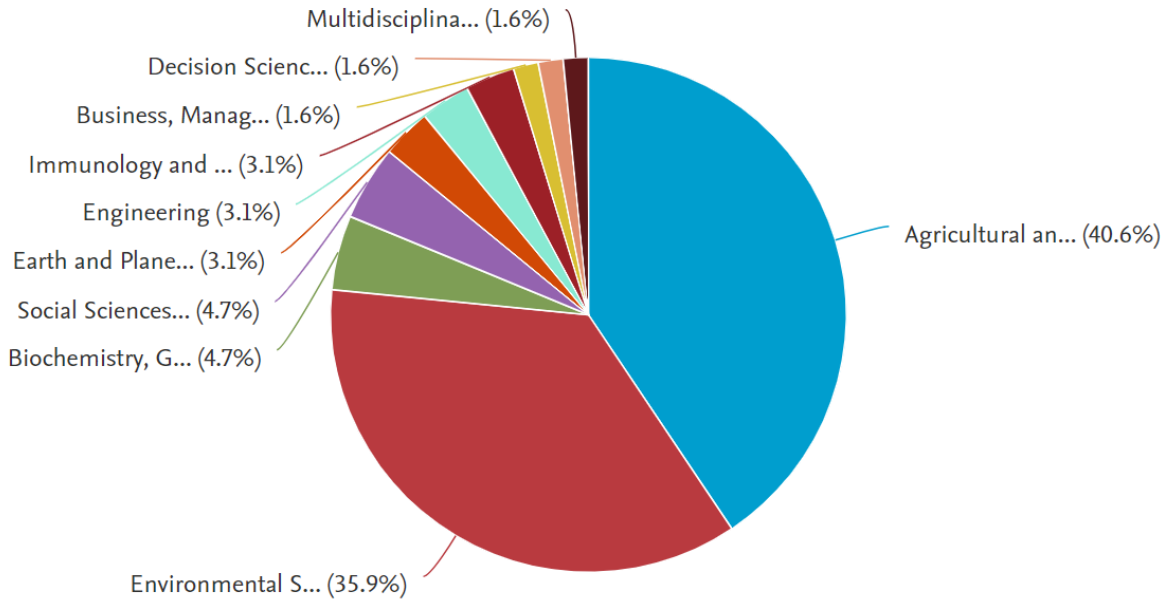

Fig. 3 | Subject area

The issue of biodiversity conservation strategy can be examined across other disciplines due to its comprehensive nature and multifaceted dimensions. Each discipline offers distinct viewpoints for comprehending and executing sustainable conservation solutions. In environmental science, the primary emphasis is on resource management and the effects of climate change on biodiversity[39,40]. Agricultural and biological sciences, ranked second, primarily address sustainability in food production and the conservation of endangered species[48,49].

Social sciences examine the impact of society on the environment and advocate for public understanding of the significance of conservation[50,51]. Simultaneously, biochemistry and genetics address conservation measures from a micro viewpoint, investigating how genetics can aid in the preservation of species diversity[52–54]. Engineering and earth sciences provide novel solutions, like environmental monitoring technology and ecosystem mapping, to aid conservation initiatives[55–57].

Despite their limited contributions, transdisciplinary studies and decision sciences facilitate the coordination of diverse fields to formulate comprehensive, data-driven conservation plans. This collaborative strategy is vital for tackling the ever-intricate and evolving conservation issues. We hypothesize that environmental science, agricultural and biological sciences, and social sciences are predominant disciplines in dialogues concerning biodiversity conservation strategies, as these fields emphasize the interplay between humans, ecosystems, and species, which are essential components of sustainable conservation initiatives.

Most globally and locally cited documents

Fig. 4 displays the data for the most globally cited papers, whereas Fig. 5 illustrates the data for the most locally cited documents. The Most Global Cited Documents figure indicates that the article "Lindenmayer DB, 2006, Biol Conserv" possesses the highest global citations count, totaling 551 citations. Additional widely referenced works include "Rudd H, 2022, Restor Ecol" with 273 citations and "Tiwari BK, 1998, Ecosyst Health" with 92 citations.

The graphic depicting the Most Local Cited Documents indicates that the article "Lindenmayer DB, 2006, Biol Conserv" is the most often cited document, receiving 2 citations. Additional papers featuring local citations, but fewer in quantity, comprise

"Kohsaka R, 2019, Ecosyst Health Sustain" and "Kurunambiyira M, 2003, Int J Des Nat Ecodyn", both receiving 1 citation. The data indicates that the paper "Lindenmayer DB, 2006, Biol Conserv" predominates in both global and local citations, signifying its substantial impact on the literature about biodiversity conservation.

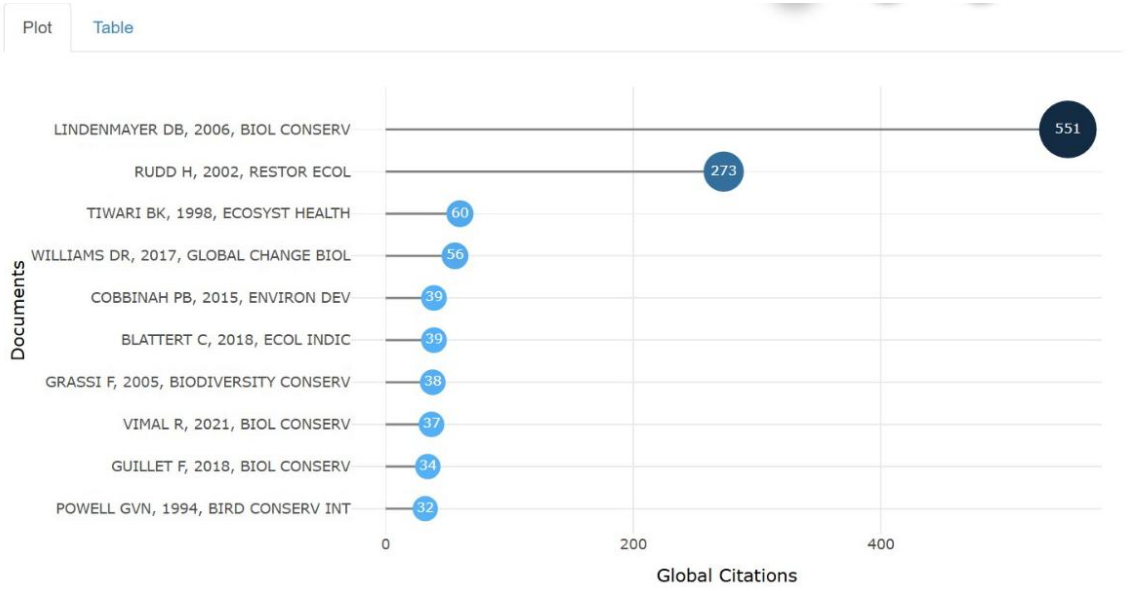

Fig. 4 | Most globally cited documents

Fig. 5 | Most locally cited documents

The most referenced document internationally is Lindenmayer DB, 2006 - Biological Conservation, with 551 citations, followed by Rudd D, 2022 - Restoration Ecology, with 373 citations, and Tiwari BK, 1998 - Ecosystem Health, with 156 citations. Other extensively referenced publications comprise Williams DR, 2017 - Global Change Biology with 100 citations, Cobbenah PB, 2015 - Environment Development with 92 citations, and Blatcett C, 2007 - Ecology Indicators with 88 citations. These texts emphasize substantial contributions to global biodiversity conservation, notably with environmental preservation and ecosystem restoration measures, with journals like Biological Conservation and Restoration Ecology serving as essential sources.

The most frequently referenced document is Lindenmayer DB, 2006 - Biological Conservation, with two citations, whereas other documents, including Kohsaka R, 2019 - Ecosystem Health Sustainability, Kurumbamaviyya M, 2003 - International Journal of Design Nature Ecosystems, Dandini SB, 2000 - Indian Silk, and Kumar S, 2022 - Parks, each garnered one citation. These locally referenced studies are more precise, concentrating on regional applications of biodiversity protection. Notwithstanding their reduced citation frequencies, they offer significant insights into conservation requirements and methods specific to certain locations. The data indicates that globally impactful biodiversity conservation research typically encompasses larger themes and cross-regional solutions, whereas locally referenced research frequently concentrates on region-specific conservation challenges. This underscores the significance of localized studies that cater to the distinct conservation needs of various places, hence enhancing the overarching findings from globally referenced research[10,58].

Most Relevant Sources

Fig. 6 illustrates that three primary journals focus on publications concerning biodiversity conservation techniques, including Biodiversity and Conservation, which has four published documents, followed by Biological Conservation, with three documents. Additional significant sources include Conservation Science and Practice and Journal of Applied Ecology, each having two documents, along with Plant Biosystems and Acta Ecologica Sinica, each providing one publication. Supplementary sources with a solitary publication comprise Ambio. American Entomologist, Asian Biotechnology and Development Review, and Biochemical and Cellular Archives.

This data indicates that Biodiversity and Conservation and Biological Conservation are the premier publications for research on biodiversity conservation strategies. These periodicals are essential resources for communicating scientific discoveries in this domain, offering basic information and novel strategies for biodiversity conservation initiatives. The variety of publications presented reflects a comprehensive approach to biodiversity conservation, incorporating diverse scientific viewpoints and methodologies.

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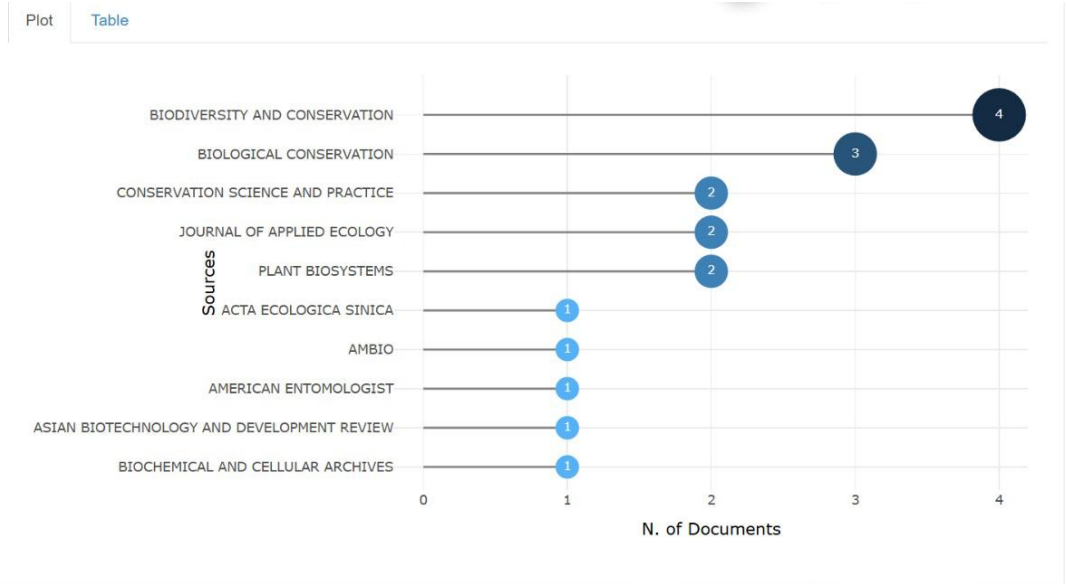

Fig. 6 | Most Relevant Sources

The primary sources for publishing articles on biodiversity conservation strategies are Biodiversity and Conservation, which has four published documents, and Biological Conservation, which has three published documents. Additional significant sources are Conservation Science and Practice and Journal of Applied Ecology, each providing two

documents, along with Plant Biosystems and Acta Ecologica Sinica, each contributing one document. Supplementary sources with a solitary publication comprise Ambio, American Entomologist. Asian Biotechnology and Development Review, and Biochemical and Cellular Archives.

Data Highland Conservation and Biological Conservation are the premier journals for research on biodiversity conservation initiatives. These periodicals are essential resources for communicating scientific discoveries in this domain, offering fundamental insights and novel strategies for biodiversity conservation initiatives. The variety of journals cited reflects a multidisciplinary approach to biodiversity conservation, incorporating several scientific perspectives and methodologies[2,9].

Author's Country and Collaboration

Fig. 7 illustrates the trend according to the author's country or territory of research in relation to Strategy Conservation Biodiversity themes, whereas Fig. 8 provides an overview of collaborations centered on this theme.

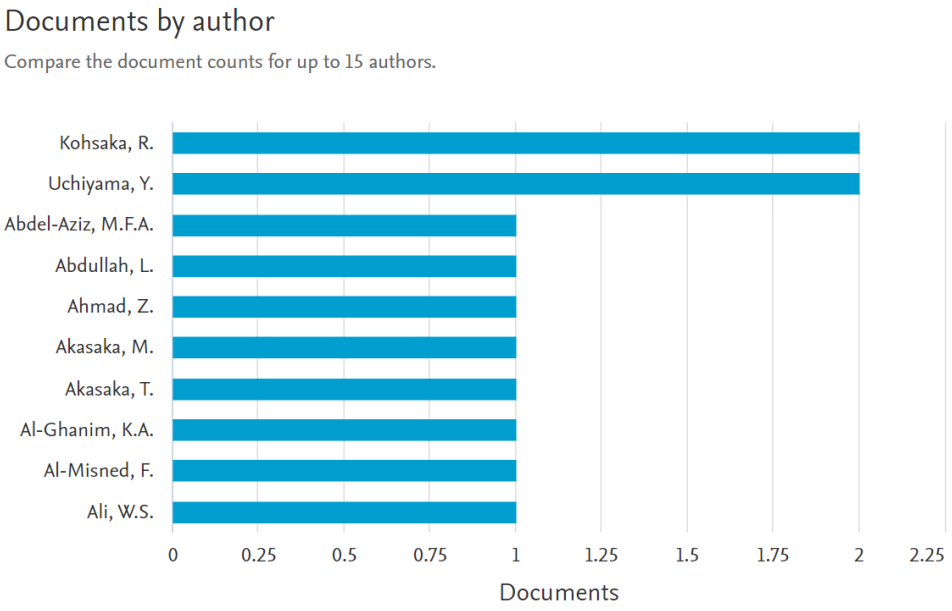

Fig. 7 | Author's country or territory

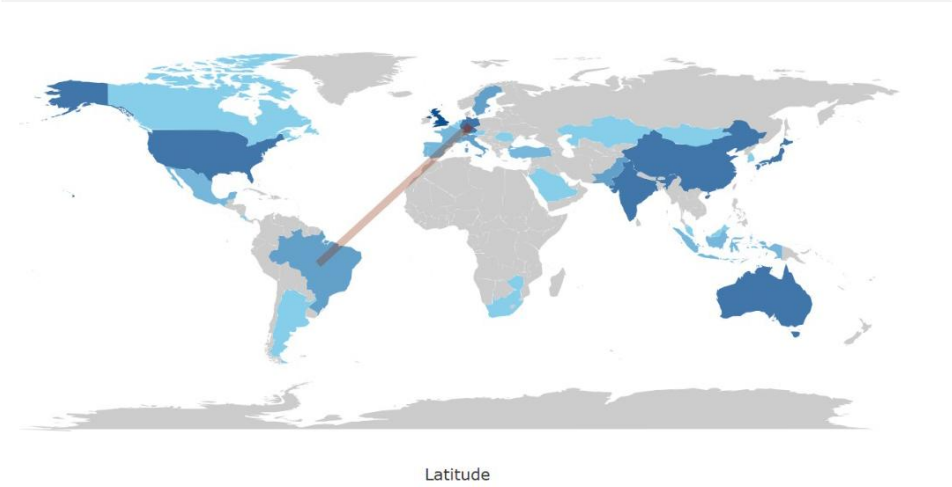

Fig. 8 | Country collaboration map

Fig. 7 illustrates the quantity of documents pertaining to biodiversity conservation released by various nations. Australia possesses the largest quantity of documents, succeeded by India, China, Japan, and the United States. Countries including Brazil, Germany, and Italy all provide substantial contributions to this research. This research demonstrates that both industrialized and developing nations exhibit a significant interest in biodiversity protection, underscoring its status as a global priority for environmental preservation. Fig. 8, a collaboration map, illustrates contacts among different countries in the publication of publications concerning biodiversity protection. Darker blue hues signify an elevated degree of collaboration. This worldwide collaboration emphasizes that biodiversity challenges cannot be addressed by individual nations independently but necessitate global alliances. Countries across the Americas, Europe, Asia, and Australia are together establishing research alliances to tackle biodiversity conservation concerns.

The research indicates that successful biodiversity conservation programs must prioritize the enhancement of scientific collaboration among nations with varied experiences and resources. A multinational strategy enables nations to exchange technology, data, and exemplary practices in biodiversity management. Moreover, nations with elevated publication rates, like Australia and India, might serve as information centers, assisting those with diminished research capabilities. Nevertheless, several countries demonstrate diminished publication outputs, which may be ascribed to various circumstances. Inadequate research funding, insufficient institutional backing, and limited access to international collaborations frequently impede scientific productivity in underdeveloped countries. Furthermore, linguistic obstacles, dependence on non-indexed regional journals, and the emphasis on urgent conservation measures over scholarly publications may exacerbate this imbalance. Comprehending these problems is essential for promoting global research equality and guaranteeing that biodiversity conservation plans are informed by a genuinely inclusive and diverse knowledge foundation. The statistics from these photos suggest that the efficacy of biodiversity conservation policies depends on the amalgamation of scientific research international collaboration, while simultaneously tackling structural impediments that restrict research contributions from specific locations[59–62].

Funding sponsor

Fig. 9 illustrates that biodiversity conservation research obtains disparate degrees of backing from various funding entities. The Ministry of Higher Education in Malaysia serves as a principal funding sponsor, endorsing numerous publications on this subject, closely followed by Universiti Teknologi MARA. Additional international entities, such as the Qatar Foundation and the Qatar National Research Fund, also make substantial contributions to this domain. Supplementary assistance is provided by entities including the Canada Foundation for Innovation, the Chinese University of Hong Kong, and the European Research Council. The availability of such financing indicates a robust commitment from these organizations to promote research on biodiversity conservation, crucial for tackling environmental concerns. The absence of transparency regarding funding sources, particularly among institutions or researchers not included in this list, may suggest two possibilities: (1) certain researchers could be undertaking studies with independent financing, or (2) disclosing funding sponsors has not yet become a normative practice in academia. Enhancing transparency in funding disclosures would advance the discipline by elucidating the significance of financial biodiversity conservation research.

Notably, various institutions from nations that may not prioritize biodiversity concerns exhibit interest in financing biodiversity conservation research, albeit the quantity remains small. The existence of institutions from many nations signifies a worldwide acknowledgment of the significance of environmental preservation and biodiversity conservation in tackling contemporary issues. This indicates that conservation efforts are perceived as transnational and transcultural matters, wherein the ideals of environmental preservation—such as

stewardship of nature and ecosystem health— possess a universal significance applicable across diverse contexts. Despite the minimal support from institutions outside nations primarily focused on biodiversity, this interest signifies an attempt to incorporate conservation viewpoints into the wider global context. It underscores the significance of cross-cultural and interdisciplinary collaboration in devising comprehensive solutions to increasingly intricate environmental challenges[63,64].

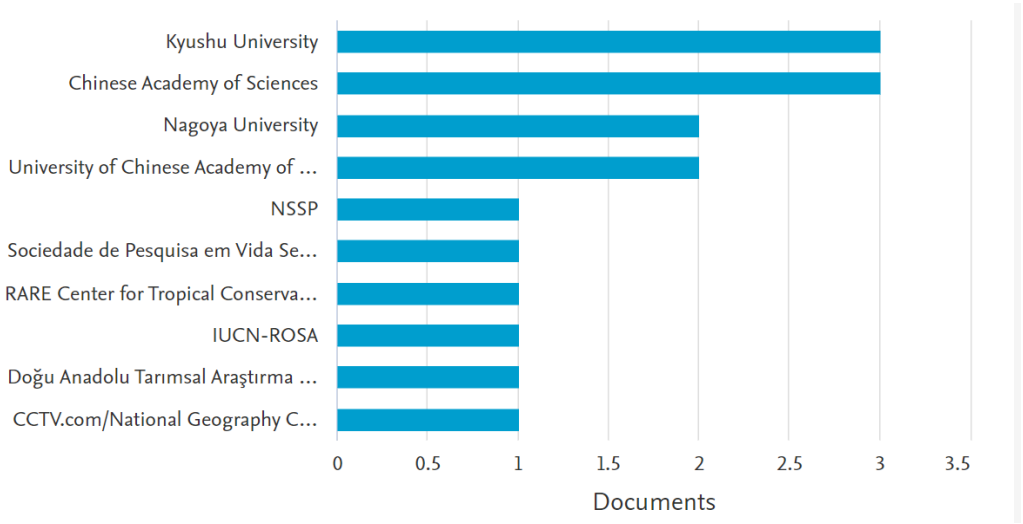

Fig. 9 | Funding sponsor

The Principal Keywords

The principal keywords in the examination of biodiversity and conservation throughout the Scopus database are illustrated through co-occurrence keyword simulation findings using VOSviewer (Fig. 10), as represented in the wordcloud (Fig. 11). Five primary keywords are prominent and interconnected with "biodiversity and conservation": biodiversity, conservation, biodiversity conservation, conservation planning, and conservation management. This relationship underscores the interrelated domains of biodiversity study, demonstrating their significance in comprehending and tackling environmental conservation issues.

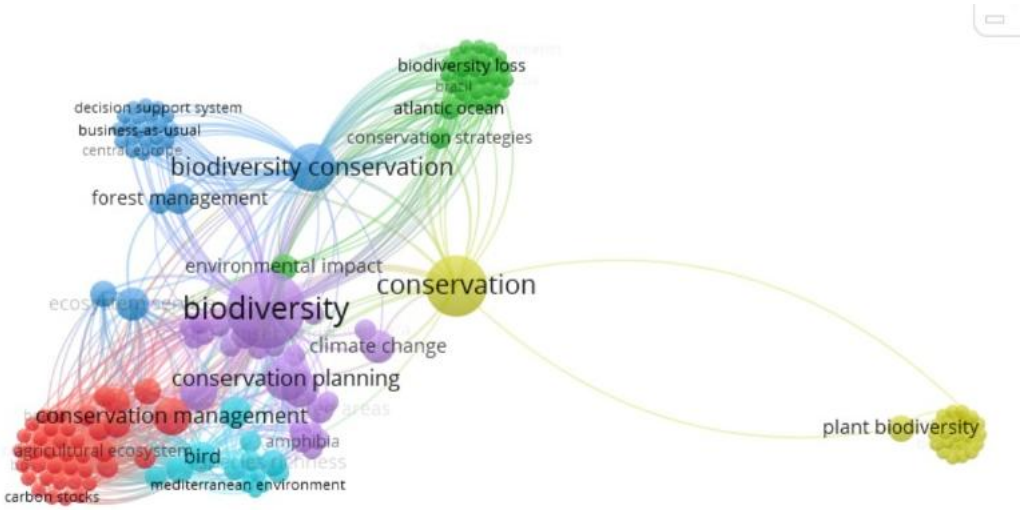

Fig. 10 |Keywords related to Islam and sustainability

Fig. 11 | Wordcloud

Fig. 10 and 11 illustrate a network visualization of interconnected terms in biodiversity and conservation research, generated using VOSviewer and RStudio. Prominent keywords like "biodiversity," "conservation," "biodiversity conservation," "conservation management," and "conservation planning" manifest as larger nodes, signifying greater relevance or frequency. The keywords are organized into clusters distinguished by various colors to illustrate thematic relationships.

The red cluster emphasizes "conservation management" and encompasses associated terms such as "agricultural ecosystem," "carbon stocks," and "bird." The blue cluster focuses on "biodiversity" and is associated with terms such as "ecosystem," "forest management," and "decision support system." The green cluster emphasizes "biodiversity conservation" and "biodiversity loss," connecting to "conservation strategies" and particular areas such as the "Atlantic Ocean." The yellow cluster centers on "conservation," linking to overarching themes like "climate change" and "environmental impact."The purple cluster pertains to subjects such as "conservation planning" and "protected areas."

We noted the intriguing connection between the terms “biodiversity”, “conservation”, and “strategic approach” with “conservation planning” and “conservation management”. The observation that the terms “biodiversity”, “conservation”, and “strategic approach” are linked to “conservation planning” and “conservation management” signifies a robust conceptual integration within the literature on biodiversity conservation. This indicates that conservation strategies encompass not only broad biodiversity conservation, but also systematic conservation planning and management[65,66]. This connection signifies that a strategic approach is crucial in formulating effective and sustainable conservation measures, from the planning phase to the execution of management[66–68]. This conclusion underscores the significance of synergy between biodiversity principles and strategic methodologies to attain comprehensive and contextual conservation objectives

Thematic Map

Fig. 12 illustrates the result of the R Studio simulation concerning the thematic map focused on biodiversity conservation techniques. The terms biodiversity, conservation, and ecosystem are located on the line representing development degree/density between basic themes and motor themes. The terms species, habitat, and wildlife are present in the motor themes section. Additionally, the phrases “climate change” and “community engagement” are present in the specialized themes section.

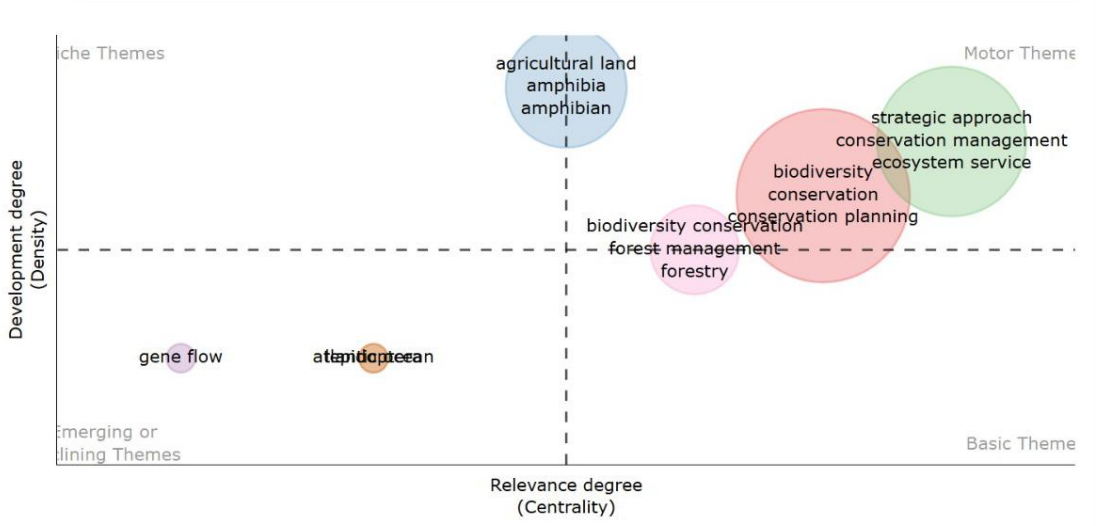

Fig. 12 | Thematic Map

Fig. 12 illustrates the topical distribution of subjects pertaining to biodiversity and conservation initiatives. Key topics are categorized into several quadrants according their relevance (centrality) and level of growth (density). The map delineates some notable clusters and insights:

The motor themes quadrant features keywords such as "strategic approach," "conservation management," and "ecosystem service," signifying that these themes are vital and propel additional study in conservation management and biodiversity sustainability. The use of these terms indicates a significant emphasis on strategic, holistic methods for environmental management and ecosystem services, highlighting their relevance in sustainability and conservation research[69–71].

Terms such as "biodiversity conservation," "conservation planning," and "forest management" are evident between the fundamental and operational issues. This transitional role underlines their fundamental importance in the discipline, with an increasing trend towards their centrality in conservation studies. These notions function as fundamental yet developing subjects that support extensive study in biodiversity conservation, forest management, and planning[72,73].

The niche themes quadrant includes "agricultural land," "amphibia," and "amphibian," indicating specialized yet peripheral topics that explore the confluence of agricultural activities with the conservation of amphibian species. Despite their specialization, these themes provide significant insights for particular research domains, such as the influence of land development on amphibian biodiversity[74,75]. In the quadrant of developing or decreasing themes, terms such as "gene flow," "Atlantic Ocean," and "landscape" emerge, signifying subjects that are either burgeoning or diminishing in relevance within contemporary research. These phrases may denote experimental or limited investigations that enhance broader discussion in biodiversity and environmental science[76,77]. Fig. 12 illustrates a discernible trend in research transitioning from fundamental and specialized concepts to predominant themes, highlighting an increasing interest in pragmatic and strategic conservation measures. This transition signifies a shift from fundamental research to more applied studies that tackle urgent environmental issues.

This work offers a thorough bibliometric examination of biodiversity conservation efforts; yet, certain limitations must be recognized. A primary constraint is the dependence on Scopus-indexed articles, potentially omitting substantial research present in grey literature, non-indexed journals, or regional reports. Consequently, specific local or policy-oriented conservation initiatives may not be entirely reflected in our research. Moreover, whereas

bibliometric tools such as VOSviewer and RStudio proficiently delineate research trends and collaboration networks, they fail to evaluate the qualitative influence of studies on actual conservation results. Future investigations may rectify these limitations by utilizing alternate databases (e.g., Web of Science, Google Scholar) and incorporating qualitative content analysis to evaluate the practical ramifications of conservation research. Incorporating policy documents, NGO reports, and official publications could offer a more comprehensive perspective on global biodiversity conservation initiatives. Additionally, examining the development of interdisciplinary collaborations and the impact of nascent study domains, such as AI-driven conservation and citizen science, may provide profound insights into the future direction of biodiversity research.

Conclusion

This bibliometric analysis highlights global trends, key topics, and research contributions in biodiversity conservation. Since 2019, publication volume has grown significantly, peaking in 2022—reflecting rising global concern for environmental issues. The field is shaped by environmental sciences, agriculture, biology, and social sciences, showing the need for a multidisciplinary approach. Countries like Australia, India, and the U.S. lead in publication output, supported by international funding from organizations such as the Ministry of Higher Education Malaysia and the Qatar Foundation. Keyword analysis points to a consistent focus on biodiversity, conservation planning, and ecosystem management. Thematic patterns show growing interest in strategic conservation, ecosystem services, and practical management. Some topics, like gene flow and amphibian conservation, are emerging or underexplored, offering directions for future research. Moving forward, stronger international collaboration, support for low-capacity countries, use of advanced technologies, and integration of social and ecological disciplines are essential. These steps will support more effective, locally relevant, and sustainable conservation strategies aligned with global development goals.

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Author contributions

All authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by **[Husamah]**, **[Aulia Mahdiyatul Dwi Zafira]**, and **[Umrohatul Dalifah]**. The first draft of the manuscript was written by **[Husamah]**, **[Aulia Mahdiyatul Dwi Zafira]**, and **[Umrohatul Dalifah]**. **[Tutut Indria Permana]**, **[Abdulkadir Rahardjanto]**, and **[Nurdiyah Lestari]** commented and provided input to strengthen concepts and discussion patterns on previous versions of the manuscript. All authors read and approved the final manuscript.