

Biodiversity Science 2000–2026 Mapping International Collaboration and Research Clusters Through Bibliometrics

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ABSTRACT

This study aims to examine the evolution of biodiversity science from 2000 to 2026 by mapping global research trends, thematic structures, and international collaboration patterns using a bibliometric approach. Data were collected from the Scopus database based on keywords related to biodiversity, conservation, and ecological sustainability, and analyzed using VOSviewer to generate co-occurrence, overlay, and density visualizations. The results show a significant growth in biodiversity-related publications, reflecting increasing global concern over environmental degradation and climate change. The analysis identifies several major research clusters, including ecological foundations, conservation management, climate change impacts, and emerging interdisciplinary areas such as public health, agriculture, and technological applications. Temporal trends indicate a shift from traditional ecological and taxonomic studies toward integrative and solution-oriented research, particularly involving artificial intelligence and participatory approaches such as citizen science. Furthermore, collaboration networks reveal strong dominance by developed countries, while contributions from developing regions are gradually increasing. This study highlights the transformation of biodiversity science into a multidisciplinary and globally interconnected field and provides insights for future research directions emphasizing inclusivity, innovation, and sustainability.

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1. INTRODUCTION

Biodiversity science has become one of the most critical research domains in the 21st century due to increasing environmental pressures such as climate change, habitat loss, and ecosystem degradation [1]. Biodiversity refers to the variety of life forms on Earth, encompassing genetic diversity, species diversity, and ecosystem diversity that collectively sustain ecological balance and human well-being. Over the past few decades,

the growing awareness of biodiversity loss has encouraged scientists, policymakers, and international organizations to intensify research efforts aimed at understanding, conserving, and sustainably managing biological resources. As a result, biodiversity studies have expanded rapidly across multiple disciplines including ecology, environmental science, conservation biology, and sustainability studies. This expansion has also been accompanied by a surge in scientific

publications and collaborative research initiatives around the world [2].

The rapid growth of biodiversity-related research has produced a vast amount of scholarly literature, making it increasingly difficult to manually track research trends, collaboration networks, and emerging scientific themes [3]. To address this challenge, bibliometric analysis has become a widely used methodological approach for evaluating scientific publications and identifying patterns within a research field. Bibliometrics involves the quantitative analysis of academic publications, citations, and related metadata to assess research productivity, impact, and intellectual structure within a specific discipline. Through statistical and network-based techniques, bibliometric methods can reveal relationships among authors, institutions, and countries, thereby enabling researchers to understand how knowledge evolves within a scientific community [4].

One of the key advantages of bibliometric studies lies in their ability to map scientific collaboration networks and research clusters. Scientific collaboration has become increasingly international, with researchers from different countries and institutions working together to address complex global issues such as biodiversity conservation and ecosystem management. Bibliometric techniques such as co-authorship analysis, citation analysis, and bibliographic coupling allow researchers to visualize collaborative relationships and identify influential contributors in a given field. For instance, the analysis of citation networks or co-authorship networks can illustrate how research communities are structured and how knowledge flows among scholars and institutions. These approaches provide valuable insights into the development of research clusters and the formation of intellectual communities within scientific disciplines.

In addition to identifying collaboration networks, bibliometric analysis is also widely used to detect research hotspots and thematic clusters within a body of

literature. By examining keyword co-occurrence and citation relationships, researchers can identify dominant topics, emerging themes, and conceptual structures that shape the evolution of a scientific field. Cluster analysis techniques, often supported by visualization tools such as knowledge mapping software, enable scholars to group related publications into thematic clusters that represent specific research directions. These clusters help to reveal how different topics are interconnected and how the focus of scientific inquiry changes over time. Consequently, bibliometric mapping provides a comprehensive overview of the intellectual landscape of a discipline and helps guide future research agendas.

Despite the increasing number of studies related to biodiversity, there remains a need for a comprehensive bibliometric investigation that focuses on global collaboration patterns and research clusters over an extended period of time. The period from 2000 to 2026 represents a significant era in biodiversity science, marked by rapid scientific advancement, increased international cooperation, and heightened global attention to environmental sustainability. During this period, global initiatives and environmental agreements have encouraged multidisciplinary research and cross-border collaboration in biodiversity conservation. Mapping the scientific output and collaborative structures during this timeframe can provide valuable insights into how biodiversity science has evolved, which countries and institutions play leading roles, and what research themes have emerged as dominant priorities. Such an analysis can contribute to a deeper understanding of the knowledge structure of biodiversity science and support strategic planning for future research and policy development.

Although biodiversity science has experienced substantial growth in publications and international collaboration, the overall structure of research development and collaboration patterns within this field is not yet fully understood. Many existing studies focus on specific subtopics of

biodiversity rather than providing a comprehensive overview of global research dynamics. As a result, there is limited knowledge regarding how international collaboration networks are formed, which institutions and countries contribute most significantly to biodiversity research, and what thematic clusters dominate the scientific landscape. Without systematic mapping of these patterns, it becomes difficult to identify emerging research trends, knowledge gaps, and opportunities for future collaboration. Therefore, a bibliometric analysis covering the period from 2000 to 2026 is necessary to provide a holistic understanding of the development, collaboration networks, and research clusters in biodiversity science.

The objective of this study is to analyze the global development of biodiversity science from 2000 to 2026 using bibliometric methods.

2. METHODS

This study employed a bibliometric research design to analyze the development of biodiversity science publications from 2000 to 2026. Bibliometric analysis is a quantitative approach used to evaluate patterns in scientific literature, including publication output, citation relationships, and collaboration networks within a specific field. The data for this study were collected from an international academic database that indexes peer-reviewed journal articles, conference papers, and review publications related to biodiversity science. The search strategy used keywords such as “biodiversity,” “biodiversity conservation,” “ecosystem

diversity,” and other relevant terms appearing in titles, abstracts, and keywords. The search was limited to publications between 2000 and 2026 to capture contemporary developments in biodiversity research. After retrieving the records, the bibliographic information—including author names, affiliations, titles, keywords, abstracts, and citation counts—was exported in a standardized format for further analysis. Duplicate and irrelevant records were removed during the data cleaning stage to ensure data accuracy and consistency.

The bibliometric data were analyzed using quantitative and network-based techniques to examine patterns of scientific productivity and collaboration. Descriptive bibliometric indicators such as the number of publications per year, most productive authors, leading institutions, and contributing countries were calculated to understand the overall growth of biodiversity research. In addition, co-authorship analysis was conducted to identify international collaboration networks among researchers and institutions. This analysis enabled the visualization of collaborative relationships and helped determine which countries or organizations played central roles in biodiversity research. Citation analysis was also applied to measure the academic influence of publications and to identify highly cited articles that significantly contributed to the development of the field. These analyses provided insights into the structure of scholarly communication and the distribution of research contributions across the global scientific community.

from traditional observational and descriptive methods toward computational and analytical techniques, enabling more precise monitoring and prediction of biodiversity patterns. Additionally, the presence of citizen science highlights the growing role of public participation and digital platforms in large-scale biodiversity data collection.

In contrast, the darker blue and purple nodes represent earlier research

themes, including genetics, animal, humans, and basic biological classification. These areas form the foundational knowledge base of biodiversity science, emphasizing species-level and biological investigations. Over time, the field has expanded from these core biological studies toward more complex, integrative frameworks that connect biodiversity with climate change, sustainability, agriculture, and public health.

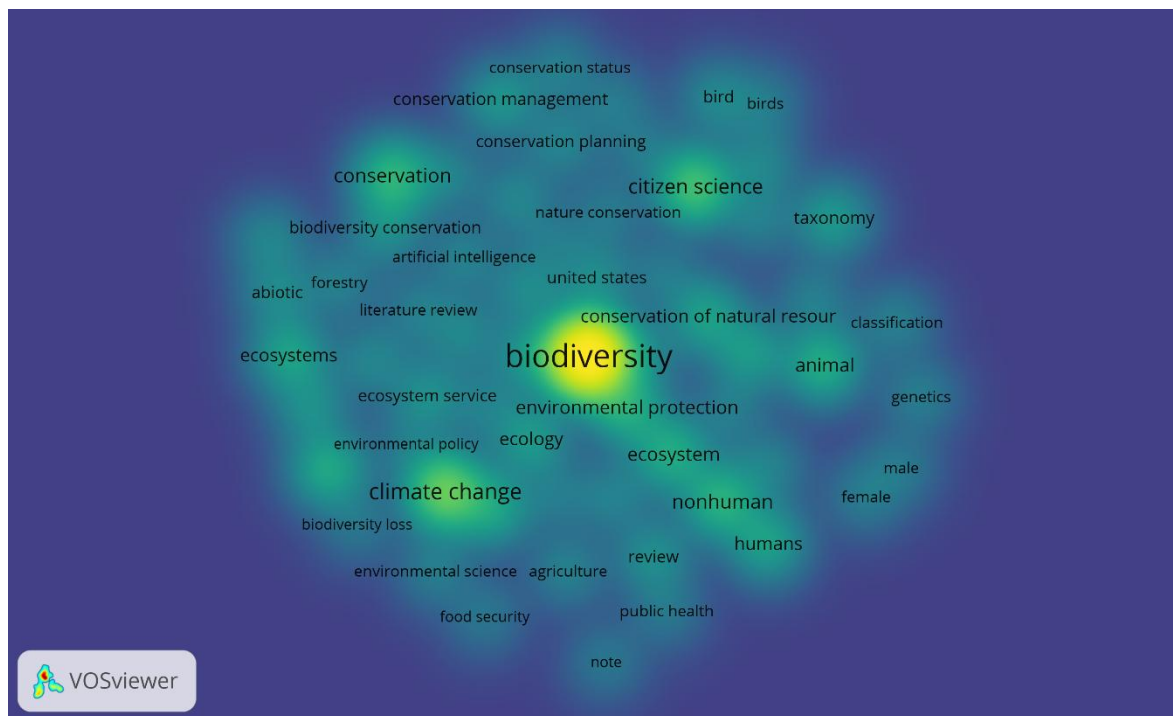


Figure 3. Density Visualization

Source: *Data Analysis, 2026*

Figure 3 highlights the concentration and intensity of research topics within biodiversity science. The brightest (yellow) areas indicate the most frequently occurring and strongly connected keywords, with biodiversity clearly emerging as the central and most dominant theme. Surrounding it, high-density terms such as environmental protection, ecosystem, ecology, and climate change suggest that the core of biodiversity research is heavily anchored in environmental and ecological concerns. The strong density around climate change further underscores its critical role as a driving force shaping biodiversity research agendas globally.

In contrast, areas with lower density (green to blue) represent more specialized or emerging topics, such as citizen science, taxonomy, genetics, public health, and artificial intelligence. These topics, while less dominant, indicate important directions for future research, reflecting a shift toward interdisciplinary integration and technological innovation. The presence of these emerging themes around the central cluster suggests that biodiversity science is expanding beyond traditional ecological studies into broader domains, including human health, data science, and participatory research approaches.

3.2 Citation Analysis

Table 1. Top Cited Documents

Citations	Authors and year	Title	Source
8,305	[5]	The worldwide leaf economics spectrum	Nature, 428(6985), pp. 821–827
5,905	[6]	Global change and the ecology of cities	Science, 319(5864), pp. 756–760
4,972	[7]	Planetary boundaries: Exploring the safe operating space for humanity	Ecology and Society, 14(2)
4,710	[8]	The diversity and biogeography of soil bacterial communities	Proceedings of the National Academy of Sciences of the United States of America, 103(3), pp. 626–631
3,853	[9]	Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools	Proceedings of the National Academy of Sciences of the United States of America, 109(40), pp. 16083–16088
3,823	[10]	Faecalibacterium prausnitzii is an anti-inflammatory commensal bacterium identified by gut microbiota analysis of Crohn disease patients	Proceedings of the National Academy of Sciences of the United States of America, 105(43), pp. 16731–16736
3,242	[11]	The pollution of the marine environment by plastic debris: A review	Marine Pollution Bulletin, 44(9), pp. 842–852
3,169	[12]	Impacts of climate warming on terrestrial ectotherms across latitude	Proceedings of the National Academy of Sciences of the United States of America, 105(18), pp. 6668–6672
3,165	[13]	Relationships between leaf pigment content and spectral reflectance across a wide range of species, leaf structures and developmental stages	Remote Sensing of Environment, 81(2–3), pp. 337–354
3,035	[14]	Microbial diversity in the deep sea and the underexplored “rare biosphere”	Proceedings of the National Academy of Sciences of the United States of America, 103(32), pp. 12115–12120

Source: Scopus, 2026

Discussion

The findings of this bibliometric study reveal that biodiversity science has evolved into a highly interconnected and multidisciplinary research domain, with biodiversity functioning as the central organizing concept across all thematic clusters. The dominance of core terms such as ecosystem, ecology, and environmental protection indicates that the field continues to

be grounded in ecological sciences while simultaneously expanding into broader environmental discourses. This aligns with the increasing recognition that biodiversity loss is not an isolated phenomenon but is deeply embedded within complex ecological and socio-environmental systems. The strong interlinkages among keywords also suggest that contemporary biodiversity research is characterized by knowledge integration rather than disciplinary fragmentation.

A key insight from the cluster analysis is the prominent role of climate change as a major driver shaping biodiversity research. The close association between biodiversity and climate-related terms reflects a paradigm shift in which biodiversity loss is increasingly framed within the context of global environmental change. This finding is consistent with recent literature emphasizing the bidirectional relationship between biodiversity and climate systems, where climate change accelerates species loss while biodiversity degradation reduces ecosystem resilience. As a result, biodiversity science is transitioning toward a more problem-oriented approach, focusing on mitigation, adaptation, and sustainability strategies rather than purely descriptive ecological assessments.

The study also highlights the growing importance of conservation-oriented and policy-relevant research. The presence of keywords such as conservation management, conservation planning, and environmental policy indicates that biodiversity research is increasingly directed toward practical applications and decision-making processes. This shift reflects the global urgency to translate scientific knowledge into actionable strategies for biodiversity protection. Moreover, the emergence of citizen science within the network suggests a democratization of biodiversity research, where public participation and community engagement play a crucial role in data collection and environmental monitoring. This participatory approach enhances both the scale and inclusivity of biodiversity research.

Another significant development identified in this study is the integration of advanced technologies and interdisciplinary approaches into biodiversity science. The appearance of terms such as artificial intelligence, classification, and taxonomy in more recent layers of the network indicates a transition toward data-driven and computational methods. These technologies enable more efficient biodiversity monitoring, species identification, and predictive

modeling, thereby enhancing the analytical capacity of the field. At the same time, the linkage of biodiversity with agriculture, food security, and public health reflects an expanding research agenda that connects ecological sustainability with human well-being and socio-economic systems.

Despite these advancements, the analysis also reveals structural challenges within the global research landscape, particularly in terms of uneven collaboration and thematic concentration. While core topics such as biodiversity and climate change dominate the field, emerging areas remain less densely connected, indicating potential gaps in research integration. Furthermore, although international collaboration is increasing, it is still largely concentrated among developed countries, suggesting disparities in research capacity and knowledge production. Therefore, future research should prioritize more inclusive global collaboration, strengthen interdisciplinary linkages, and explore underrepresented themes to ensure a more holistic and equitable development of biodiversity science.

4. CONCLUSION

This study provides a comprehensive overview of the evolution of biodiversity science from 2000 to 2026 through bibliometric analysis, revealing a dynamic and increasingly interdisciplinary research landscape. The findings demonstrate that biodiversity remains a central and unifying concept, with strong connections to key themes such as climate change, ecosystem services, conservation, and environmental policy. Over time, the field has shifted from traditional ecological studies toward more integrative, technology-driven, and solution-oriented approaches, incorporating elements such as artificial intelligence, citizen science, and sustainability frameworks. Despite the growth in global research output and collaboration, disparities across regions and emerging thematic gaps persist. Therefore, future research should emphasize inclusive international collaboration, interdisciplinary

integration, and the development of innovative methodologies to effectively

address the complex and evolving challenges of biodiversity conservation.

REFERENCES

- [1] R. P. Chaudhary, "Forest conservation and environmental management in Nepal: a review," *Biodivers. Conserv.*, vol. 9, pp. 1235–1260, 2000.
- [2] S. Barroso, F. R. Pinto, A. Silva, F. G. Silva, A. M. Duarte, and M. M. Gil, "The circular economy solution to ocean sustainability: Innovative approaches for the blue economy," in *Research Anthology on Ecosystem Conservation and Preserving Biodiversity*, IGI Global Scientific Publishing, 2022, pp. 875–901.
- [3] L. Rist, L. Feintrenie, and P. Levang, "The livelihood impacts of oil palm: smallholders in Indonesia," *Biodivers. Conserv.*, vol. 19, pp. 1009–1024, 2010.
- [4] D. S. Wilkie, J. F. Carpenter, and Q. Zhang, "The under-financing of protected areas in the Congo Basin: so many parks and so little willingness-to-pay," *Biodivers. Conserv.*, vol. 10, no. 5, pp. 691–709, 2001.
- [5] I. J. Wright *et al.*, "The worldwide leaf economics spectrum," *Nature*, vol. 428, no. 6985, pp. 821–827, 2004.
- [6] N. B. Grimm *et al.*, "Global change and the ecology of cities," *Science (80-.)*, vol. 319, no. 5864, pp. 756–760, 2008.
- [7] J. Rockström *et al.*, "Planetary boundaries: exploring the safe operating space for humanity," *Ecol. Soc.*, vol. 14, no. 2, 2009.
- [8] N. Fierer and R. B. Jackson, "The diversity and biogeography of soil bacterial communities," *Proc. Natl. Acad. Sci.*, vol. 103, no. 3, pp. 626–631, 2006.
- [9] K. C. Seto, B. Güneralp, and L. R. Hutyrá, "Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools," *Proc. Natl. Acad. Sci.*, vol. 109, no. 40, pp. 16083–16088, 2012.
- [10] H. Sokol *et al.*, "Faecalibacterium prausnitzii is an anti-inflammatory commensal bacterium identified by gut microbiota analysis of Crohn disease patients," *Proc. Natl. Acad. Sci.*, vol. 105, no. 43, pp. 16731–16736, 2008.
- [11] J. G. B. Derraik, "The pollution of the marine environment by plastic debris: a review," *Mar. Pollut. Bull.*, vol. 44, no. 9, pp. 842–852, 2002.
- [12] C. A. Deutsch *et al.*, "Impacts of climate warming on terrestrial ectotherms across latitude," *Proc. Natl. Acad. Sci.*, vol. 105, no. 18, pp. 6668–6672, 2008.
- [13] D. A. Sims and J. A. Gamon, "Relationships between leaf pigment content and spectral reflectance across a wide range of species, leaf structures and developmental stages," *Remote Sens. Environ.*, vol. 81, no. 2–3, pp. 337–354, 2002.
- [14] M. L. Sogin *et al.*, "Microbial diversity in the deep sea and the underexplored 'rare biosphere,'" *Proc. Natl. Acad. Sci.*, vol. 103, no. 32, pp. 12115–12120, 2006.