



Mapping the Intellectual Structure and Thematic Evolution of Research on Iran's Biodiversity: A Scientometric Analysis

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ABSTRACT

Aims: This study uses a scientometric approach to investigate Iranian biodiversity research and identify thematic structures and trends.

Materials & Methods: This study uses a descriptive scientometric approach and the Scopus database to analyze biodiversity research in Iran, with a query developed based on expert feedback. The query, designed to retrieve relevant documents while excluding unrelated terms, yielded 1758 entries, which were analyzed using Bibliometrix software with its Biblioshiny interface.

Findings: The analysis showed that 1758 documents on biodiversity in Iran were published between 1984 and 2025. Word and concept frequency increased after 2008, with the ten keywords showing upward trends. The keyword Iran showed an earlier upward trend in retrieved publications, beginning around 2003. Biodiversity and animal were the next most prominent concepts, while taxonomy, species richness, distribution, conservation, water quality, ecosystem, and the Middle East also increased in the literature. Co-word analysis identified three clusters: biodiversity conservation and forest ecosystems in Iran; biogeography and animal phylogeny; and biodiversity issues from a marine perspective.

Conclusion: Biodiversity research in Iran has gradually shifted from descriptive, species-focused studies toward more applied themes related to conservation, ecosystems, and environmental management. Taxonomy and biogeography remain foundations, while conservation-related topics are receiving increasing attention. These thematic patterns can clarify research priorities and highlight areas for further study. These findings may help link biodiversity research and conservation planning in Iran. Future progress would benefit from stronger interdisciplinary collaboration, improved biodiversity data resources, and closer integration of basic research with conservation practice.

Keywords: Biodiversity; Bibliometrix; Co-word Analysis; Intellectual Structure; Iran.

CITATION LINKS

[1] Akhane H., Djamali M., Ghorbanalizadeh A., Ramezani... [2] Noroozi J., Talebi A., Doostmohammadi M., Manafzade... [3] Noroozi J., Talebi A., Doostmohammadi M., Rumpf S.B... [4] Kazemi S.M., Hosseinzadeh M.S. High Diversity and E... [5] Ghanbarifardi M. Habitat Heterogeneity Influences I... [6] Noori S., Zahiri R., Yusefi ... [7] Hood W.W., Wilson C.S. The Literature of Bibliometr... [8] Heidari G. Epistemological assumptions of scientome... [9] Chen C. Science Mapping: A Systematic Review of the... [10] Zupic I., Čater T. Bibliometric Methods in Manageme... [11] Zandi Ravan N., Davarpanah M., ... [12] Cobo M.J., López-Herrera A.G., Herrera-Viedma E., H... [13] Ahmadi H., Osareh F. Co-word Analysis Concept, Defi... [14] Liu X., Zhang L., Hong S. Global biodiversity resea... [15] Ali H., Adithya Kumari A. Biodiversity: a scientome... [16] Ali H., Adithya Kumari H. ... [17] Stork H., Astrin J.J. Trends in Biodiversity Resear... [18] Gangahagedara R., Subasinghe S., Lankathilake M., A... [19] Yu S., Cui B., Xie C., Man Y., Fu J. Bibliometric R... [20] Tan Y.L., Yiew T.H., Habibullah M.S., Chen J.E., Ma... [21] Fazeli-Varzaneh M., Bettinger P., Ghaderi-Azad E., ... [22] Hadi M., Hashemkhani M., Irvani E. The trend of sc... [23] Yarizanganeh M., Mostafavi I., Dastar Y. Content An... [24] Rahimi S., Karmi T. Cluster Analysis and Mapping Th... [25] Akyıldız G. K., Altındağ, A., Tavşanoğlu, Ü. N. Rec... [26] Al-Mutairi K.A. From desert margins to global insig... [27] Aria M., Cuccurullo C. *Bibliometrix*: An R tool for ... [28] Freeman L.C. A Set of Measures of Centrality Based ... [29] Freeman L.C. Centrality in social networks: concept... [30] Page L., Brin S., Motwani R., Winograd T. The PageR... [31] Brin S., Page L. The anatomy of a large-scale hyper... [32] Biodiversity Research in 2024: A Global Perspective... [33] Sagheb-Talebi K., Attar F., Sadeghzadeh Hallaj M.H.... [34] Fazeli-Varzaneh M. An investigation of the literatu... [35] Fazeli-Varzaneh M., Shahmirzadi T., Masoum Tamimi M... [36] Kimura H., Watanabe Y. Oceanic anoxia at the Precam... [37] Harzhauser M., Kroh A., Mandic O., Piller W.E., Göh... [38] Bahram M., Pölme S., ... [39] Riehl S., Zeidi M., Conard N.J. Emergence of agricu... [40] Pirbalouti A.G., Hashemi M., Ghahfarokhi F.T. Essen... [41] Pimenov M.G., Leonov M.V. The Asian Umbelliferae bi... [42] Amiraslani F., Dragovich D. Combating desertificati... [43] Augustinos A.A., Santos-Garcia D., Dionyssopoulou E... [44] Azra M.N., Noor M.I.M., Rasdi N.W., Ghaffar M.A. A ...

Introduction

Because of its unique geography, climatic diversity, and position at the intersection of several biogeographical regions, Iran's biodiversity is among the richest biological reserves in Southwest Asia. Diverse ecosystems, including the Hyrcanian forests, Zagros woodlands, steppe and desert landscapes, alpine mountain ecosystems, wetlands, and marine ecosystems, have produced a wide range of plant and animal species in the country ^[1-6]. Every scientific phenomenon or issue requires systematic research to solve problems, develop technology, and expand the boundaries of knowledge. As scientific production across fields increases, evaluating and analyzing these outputs has become increasingly important for identifying research trends, outlining the structure of knowledge, and supporting scientific and research policymaking ^[7]. One field that studies and evaluates scientific production is scientometrics, which uses quantitative indicators and methods to analyze the structure and development of science. By examining and quantifying a scientific field's system and structure, scientometrics assesses an intellectual domain's achievements and even predicts possible directions for future development. Although science and scientific research are multidimensional activities that must be examined from different perspectives, scientometrics uses quantitative data on the production, distribution, and use of scientific texts to describe science and scientific research and identify its characteristics ^[8]. One of scientometrics' most important applications is drawing scientific maps. These maps help researchers identify knowledge boundaries in a specific field and understand

hidden connections between theories and topics ^[9]. These methods are widely used to identify scientific trends, uncover research gaps, map a field's knowledge structure, and support research evaluation and policymaking ^[10]. Researchers create these scientific maps using techniques such as word co-occurrence analysis, co-citation, and scientific network analysis ^[11, 12].

Co-word analysis is a method of content analysis that is obtained through the co-occurrence of words or concepts in texts and sources, and through it, the main concepts of a field or scientific field can be identified and, through this identification, the conceptual patterns and events, scientific structure, conceptual network, hierarchical relationships of concepts, and conceptual categories of that field can be discovered, mapped, and managed. Co-word analysis is a tool for discovering hidden patterns and emerging conceptual events ^[13].

A literature review shows that researchers have examined this area from a scientometric perspective. For example, Liu et al. performed a bibliometric analysis of biodiversity research published between 1900 and 2009, using the Science Citation Index (SCI) database. Their findings showed that scientific output in this field grew explosively since the 1990s, marked by significant increases in collaboration, references, and citations. The study highlighted "ecology," "environmental sciences," "biodiversity conservation," and "plant science" as the most frequently used subject categories. It also identified journals such as "Biological Conservation" and "Biodiversity and Conservation" as leading periodicals in the field. Moreover, the United States emerged as the largest contributor to global biodiversity research, maintaining a central position in

collaboration networks and housing the highest number of top research institutions. Lastly, keyword analysis underscored the central role of “conservation” in biodiversity studies while showing growing adoption of advanced technologies and increasing academic interest in understanding both ecosystem patterns and underlying processes ^[14].

Ali and Kumari (2015) examined biodiversity research output from 2003–2012 across parameters including share and citation impact, international collaborative papers, contributions from various subject fields, and the productivity and citation profiles of top Indian institutions and authors. The Web of Science database was used to retrieve data for 10 years ^[15].

In another study, Ali and Kumari (2018) carried out a scientometric analysis of global biodiversity literature indexed in the Web of Science Core Collection from 1989 to 2016, examining 154654 publications to identify research trends and patterns. The study found a decline in the relative growth rate of publications alongside an increase in publication doubling time, indicating slower growth in research output. Collaborative research dominated the field, with 90.01% of publications being multi-authored. Chinese Academy of Sciences emerged as the most productive institution with 2305 publications, while K. J. Gaston was the most prolific author, with 257 publications. Additionally, 15.66% of publications received no citations, reflecting variation in the impact and visibility of biodiversity research ^[16].

In a bibliometric analysis of approximately 69000 biodiversity-related publications indexed in the Web of Science database, Stork and Astrin (2014) examined the growth and

thematic evolution of biodiversity research. The study reported a rapid increase in publications, authors, and journals since the 1980s, followed by a slower growth rate after 2008. Analysis of publication titles indicated a growing emphasis on community-level biodiversity studies, while molecular biodiversity remained comparatively underrepresented. Additionally, climate-related topics emerged as an increasingly important research area, and the study highlighted a significant geographical mismatch between research efforts and biodiversity’s global distribution ^[17].

Gangahagedara et al. (2021) investigated global research trends in ecosystem services (ES) through a systematic review and bibliometric analysis of highly cited articles. They collected data from the SCI-E, ESCI, and SSCI databases in the Web of Science Core Collection, covering 2000–2020. After applying a citation threshold of at least 200 citations, we selected 128 highly cited articles for analysis. The findings showed that the keyword “ecosystem services” was strongly linked to biodiversity, valuation, marine spatial planning, and conservation planning. The United States, Canada, China, France, and Australia led in highly cited publications and scientific collaboration networks. Major contributing institutions included the University of Minnesota, the University of California–Santa Barbara, and the Chinese Academy of Sciences. Among the authors, Benjamin Halpern was recognized as one of the most influential researchers for his model analyzing global anthropogenic impacts on marine ecosystems. The most frequently studied ES fields were terrestrial, urban, and marine environments ^[18].

Yu et al. (2022) conducted a systematic review of research on biodiversity offsetting

from 1992 to 2019 in their study titled "Bibliometric Review of Biodiversity Offsetting During 1992–2019." They employed bibliometric and social network analysis methods. Their findings showed that publications in this field have surged since 2002. The study identified Biological Conservation as the most productive journal, the United States as the leading country, and Dr. Maron from the University of Queensland as the most prolific author. Co-authorship analysis revealed a well-connected collaboration network among key scholars and countries, with authors from the United States, Australia, and the United Kingdom showing the highest levels of cooperation. This collaboration has primarily been driven by policy initiatives related to biodiversity offsetting. The review also emphasized that while biodiversity offsetting research is still developing rapidly, it covers a diverse range of topics. However, most studies focus on terrestrial environments, making this approach more challenging to apply in aquatic ecosystems ^[19].

Tan et al. (2023) conducted a study titled "Research Trends in Biodiversity Loss: A Bibliometric Analysis," in which they examined the global scientific landscape regarding biodiversity decline. They used a dataset of 6,599 publications retrieved from the Web of Science Core Collection. Their bibliometric findings indicate that research on biodiversity loss is expected to increase significantly in the near future. However, the study also identified a critical gap in the literature: research on biodiversity loss has received relatively little academic attention that incorporates social sciences and economics. Additionally, geographic and institutional analyses revealed that the United States leads this field, dominating

global research production and international collaboration networks ^[20].

Fazeli-Varzaneh et al. (2021) conducted a bibliometric analysis of forestry research in the Middle East and found a steady increase in scientific publications between 2005 and 2019. The findings highlighted the important roles of international collaboration, research funding, and publication in high-ranking journals in enhancing scientific visibility and citation impact. Keyword analysis further identified species, forests, trees, and environmental conditions as the dominant research themes across the region ^[21].

Hadi et al. (2022) used a scientometric approach to study trends in climate change research in Iran. They collected data from the Scopus database, including 2253 Iran-affiliated publications from 1991 to December 2019. They retrieved data using keywords such as "climate change," "global warming," "climate variability," and "greenhouse gases," and analyzed the results in R. The findings indicated exponential growth in climate change research in Iran, with about 25% of publications resulting from international collaboration. Keyword analysis showed that topics like "downscaling," "energy," "global warming," and "uncertainty" were among the most frequently studied. In contrast, critical issues such as "adaptation" and "vulnerability" received relatively limited attention. The study emphasizes the need for future research to focus more on climate change adaptation, vulnerability assessment, greenhouse gas emissions, energy consumption management, and renewable energy, especially given Iran's significant contribution to greenhouse gas emissions and the increasing impacts of climate change ^[22].

Yarizandene et al. (2025) analyzed

Iranian researchers' scientific output on climate change using the Web of Science database, covering 2002 to 2024. Their findings revealed a significant increase in publications, particularly in recent years. The most active journals focused on climate change, sustainable development, and water resource management. The leading institutions in this area included the University of Tehran, Islamic Azad University, and Tarbiat Modares University. The study identified key research themes: climate change management, water resources, rainfall analysis, resource allocation, and biodiversity conservation. This research highlights collaboration trends and patterns that can inform future climate change research and policymaking ^[23].

Rahimi and Karmi (2025) examined the conceptual structure of environmental research indexed in the ISC database. Using scientometric techniques and co-word analysis, they analyzed 1985 ISC documents to identify trends in environmental research over a specified period. They used cluster analysis and strategic diagrams to map the field's conceptual structure, identify subfields, and explore their relationships. The conceptual structure of this field comprises seven clusters: (1) Environmental Law and Ethics, (2) Environmental Innovation Ecosystem, (3) Iran's Economy and Environment, (4) Urban Pollution and Sustainability, (5) Environmental Behavior and Awareness, (6) Environmental Safety and Health, and (7) Sustainable Development Education. Additionally, a content analysis of articles published over the past 26 years identified emerging topics in environmental studies. These clusters reflect the field's key dimensions and topics ^[24].

Recent bibliometric research from other

biodiversity-rich countries also provides relevant regional context. However, these studies generally focus on specific components of biodiversity rather than the biodiversity research system as a whole. For example, Akyıldız et al. (2025) conducted a bibliometric analysis of freshwater zooplankton research at the global and national levels, focusing on Türkiye and identifying themes such as abundance, diversity, water quality, and bioindicators ^[25]. Similarly, Al-Mutairi (2025) examined floristic diversity and conservation in the arid regions of Tabuk and Khulais, Saudi Arabia, using a bibliometric and ecological synthesis. These studies provide useful regional context and demonstrate country-level bibliometric research on specific biodiversity components; however, their narrower taxonomic, ecological, or geographic scopes do not provide directly comparable benchmarks for the comprehensive national-level mapping of biodiversity research undertaken in the present study ^[26]. In other words, Previous bibliometric studies in the region have examined specific components or related areas of biodiversity research, including forestry, floristic diversity, and particular taxonomic or ecosystem-level topics. However, these studies differ in scope and therefore do not provide a directly comparable benchmark for the national-level biodiversity literature examined in the present study.

A literature review shows that researchers have examined various environmental and biodiversity aspects from a scientometric perspective. To the best of our knowledge, no previous study has provided a comprehensive scientometric mapping of Iran's national-level biodiversity research literature. One

relevant study by Liu et al. examined global biodiversity research up to 2009. This study used the Web of Science database and did not aim to map the conceptual structure, distinguishing it from the present research in both data source and time period; it also examined global research, whereas our study focuses on Iranian biodiversity research. Therefore, this study uses a scientometric approach to investigate Iranian biodiversity research and uncover the thematic structures and trends that have emerged in this area. This study's primary contribution is empirical, not methodological. By systematically mapping biodiversity research in Iran, the study identifies the principal thematic areas, conceptual relationships, research trends, and emerging topics in this national research landscape. This evidence provides a baseline for researchers, research institutions, and policymakers seeking to understand the development and priorities of biodiversity research in Iran.

Materials & Methods

This study employs a descriptive research methodology with a scientometric approach, specifically utilizing co-word analysis. We extracted data from Scopus, one of the world's most reputable citation databases and widely used in scientometric studies. We developed the search strategy iteratively and refined it through expert review. We used Scopus AI and ChatGPT (OpenAI) during initial query development to identify relevant terminology, synonyms, related concepts, and alternative expressions. Experts with relevant subject and scientometric expertise then reviewed the query, and we used their feedback to refine the terminology and Boolean structure before the final search. We introduced exclusion terms to improve

retrieval precision and reduce false-positive records not directly relevant to the study's substantive focus. In particular, we excluded terms such as human, patient, clinical, disease, cancer, and medicine to reduce retrieval of records primarily concerned with human health and medical research. Similarly, we excluded microbiome and genome to reduce retrieval of molecular and microbiome-related studies outside the scope of the present analysis. Although genetic diversity is conceptually an important component of biodiversity, we excluded it as an operational retrieval decision because including it would have retrieved many medical, human-genetics, and other genetics-oriented records not directly relevant to the study's focus. Thus, its exclusion was intended to improve the precision of the retrieved dataset rather than to exclude genetic diversity from the conceptual definition of biodiversity.

Importantly, excluding "genetic diversity" referred specifically to the exact phrase and did not exclude genetics-related research in general. The query was finalized and used to obtain the data on February 11, 2026:

(TITLE-ABS-KEY (biodiversity OR "biological diversity" OR "species diversity" OR "species richness" OR "ecosystem diversity") AND TITLE-ABS-KEY (Iran OR Iranian OR "Iranian plateau") AND TITLE-ABS-KEY (species OR fauna OR flora OR ecosystem OR habitat OR conservation OR ecology)) AND NOT TITLE-ABS-KEY (human OR patient OR clinical OR disease OR cancer OR medicine OR "genetic diversity" OR microbiome OR genome) AND PUBYEAR > 1983 AND PUBYEAR < 2026.

This query retrieved 1758 documents. We analyzed the data using Bibliometrix software, written in R and with a graphical interface called Biblioshiny ^[27].

After the initial analysis, to ensure a uniform

and comprehensive analysis, we identified synonymous terms with the help of ChatGPT (OpenAI) and field experts. We entered them into the software using its unification capabilities. For example, from the words animal, animals, animalia, and nonhuman, we selected animal, and the software unified the other words and treated them as the same as the selected word. Also, considering that some words were used as general indexing terms in the Scopus database or that the keywords used by the authors of the articles did not indicate the subject under study, they were added to the software in the form of a stop list, and these words were removed from the map and other analyses, for example, article, male, and female. The complete thesaurus and stoplist are provided in the Supplementary file.

We used Bibliometrix/Biblioshiny to perform a keyword co-occurrence analysis and explore the conceptual structure of biodiversity research in Iran. We included all keywords in the analysis. Before constructing the network, we standardized synonymous and closely related terms using a thesaurus, and removed irrelevant bibliographic and methodological terms using a predefined stop list. The analysis retained 50 keyword nodes, each with at least five edges. We normalized the resulting co-occurrence network using the association method and applied the Louvain algorithm for community detection. We removed isolated nodes. Ultimately, the resulting network consisted of three clusters, which were interpreted based on the keywords and their co-occurrence relationships. Interpretation focused primarily on keywords that were prominent in frequency, network structure, or temporal trends and substantively relevant to the research objectives.

For author-level descriptive analysis, we obtained author information from Scopus records and processed it using Bibliometrix/Biblioshiny. The Scopus dataset included author identifiers (Author(s) ID), which we retained. We performed no additional independent or manual author-disambiguation procedure. Therefore, author productivity indicators reflect the author identities provided by the Scopus database and may still be limited by database-level author identification, including potential homonymy or variations in author-name representation.

Findings

Data analysis showed that 1758 documents on biodiversity in Iran were published between 1984 and 2025. These publications were published in 702 journals and involved 4829 authors. The retrieved dataset showed an annual publication growth rate of 13.05%, an average of 4.15 authors per article, and an international collaboration rate of 38.74%. Figure 1 presents these indicators, along with other descriptive characteristics of the retrieved documents. Bibliometrix/Biblioshiny calculated these descriptive indicators from the retrieved Scopus records.



Figure 1) Descriptive information of data extracted from scientific publications in the field of Iran biodiversity, indexed in the Scopus database during the years 1984-2025.

(Source: Biblioshiny software)

The annual trend (Figure 2) shows an overall increase in Scopus-indexed publications on biodiversity in Iran, peaking in 2022, followed by a slight decline in subsequent years.

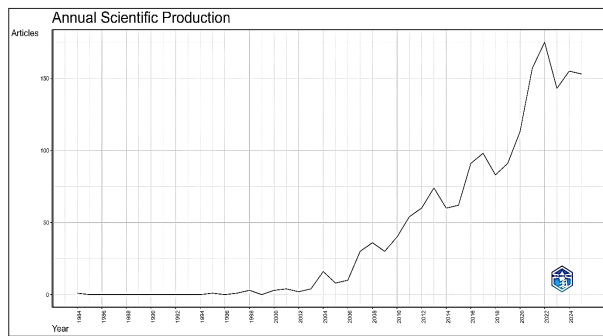


Figure 2) Annual growth trend of Iran's biodiversity scientific production in the Scopus database during the years 1984-2025.

(Source: Biblioshiny software)

A total of 702 journals published documents related to Iranian biodiversity in the Scopus database during 1984–2025, with Zootaxa being the most productive source (45 documents), followed by Braconidae of the Middle East (29) and Zoology in the Middle East (29) and Zoology in the Middle

East (26) (Figure 3-A). Among authors, Ghahari leads with 51 publications. The 10 most productive authors are shown in Figure 3-B. By organizational affiliation, the University of Tehran had the most publications (449), closely followed by Islamic Azad University (442), while Ferdowsi University of Mashhad ranked third (259) (Figure 3-C). In terms of global citation impact, Kimura and Watanabe's (2001) study on oceanic anoxia at the Precambrian–Cambrian boundary, based on sections in northern Iran, was the most highly cited document among the retrieved records, with 516 global citations. Although the study addresses faunal change and extinction during the Precambrian–Cambrian transition, it focuses primarily on geology and paleoenvironments rather than ecological biodiversity. Figure 3-D shows the 10 most-

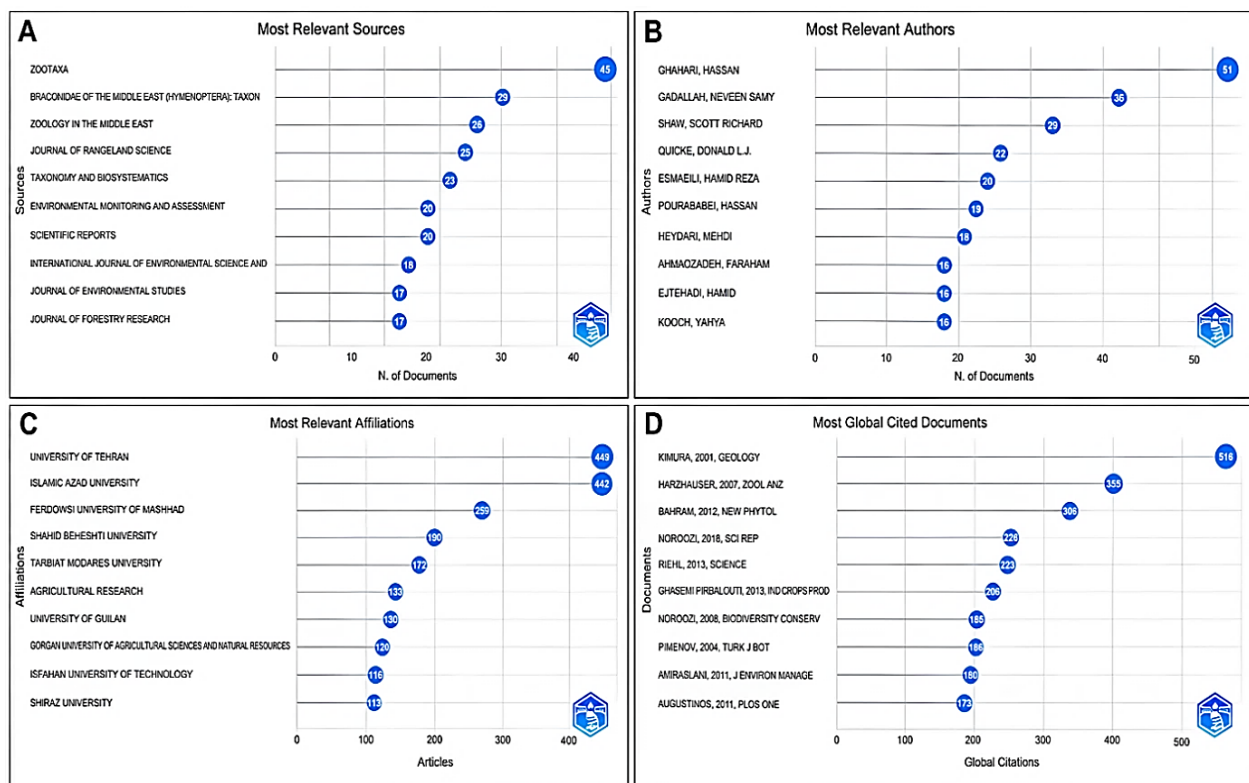


Figure 3) Main bibliometric characteristics of Iranian biodiversity research in the Scopus database during 1984–2025. (A) Most relevant sources, (B) most relevant authors, (C) most relevant affiliations, and (D) most globally cited documents in Iranian biodiversity research based on the Scopus database during 1984–2025.

(Source: Biblioshiny software)

cited documents among the retrieved records. Overall, the figure highlights leading publication sources, the most prolific authors, the most productive affiliations, and the most influential documents in Iranian biodiversity research.

Analysis of Keywords and Concepts

An examination of the most frequently used concepts and keywords shows that biodiversity and Iran rank highest, which is not surprising given the topic under study. After these two main keywords, the words animal (369 occurrences) and species richness (262 occurrences) follow. Table 1 presents the 20 most frequent words in the retrieved articles, along with their occurrences.

Table 1) The most frequent words in articles on Iranian biodiversity in the Scopus database during the years 1984-2025.

Words	Occurrences
Biodiversity	1270
Iran	954
Animal	369
Species Richness	262
Taxonomy	254
Conservation	208
Distribution	185
Phylogeny	172
Ecosystem	144
Climate Change	128
Middle East	127
New Species	125
Soil	113
DNA	111
Conservation Management	108
Morphology	100
Vegetation	99
Genetics	98
Fauna	87
Zagros Mountains	81

Analyzing Trend Topics Over Time

This section will examine the words and concepts featured in the articles from two perspectives. The first perspective, Word Frequency Over Time, shows how the frequency of one or more words changes over time. It outputs a line graph showing either the absolute or relative frequency of these words.

The second perspective, Trend Topics, offers a higher-level analysis. This aspect highlights the most prevalent keywords in each period and shows how they shift from one period to another. Trend Topics aims to identify and showcase emerging and popular topics (keywords) across different time frames. Its output is a bubble/dot chart over time that highlights the emergence, persistence, and decline of various research topics.

Figure 4 shows the frequency of words and concepts during the study period. According to this graph, the ten main keywords and concepts have grown significantly since 2008, and most relate to the keyword Iran, whose frequency began rising earlier than the other concepts, around 2003. However, biodiversity ranks second. The next word with the highest growth in occurrence in scientific texts in this field over the years under study is animal, which indicates the importance of this concept in the topics under study. Taxonomy, Species richness, distribution, Conservation, Water quality, Ecosystem, and Middle East also grew and appeared in scientific texts in this field in roughly the same direction during the years under study.

Trend Topics illustrates the changing and emerging research themes over time. By displaying keywords from different years, this chart highlights which topics have garnered more attention during specific periods and

Table 2) Topic trends of articles on Iranian biodiversity in the Scopus database during the years 1984-2025.

Year(Q3)	Year(Median)	Year(Q1)	Frequency	Term
2023	2000	1998	5	Ichthyofauna
2005	2004	2004	6	Eastern Hemisphere
2017	2004	2004	6	<i>Meleagris gallopavo</i>
2007	2006	2006	5	<i>Acipenser persicus</i>
2009	2007	2006	67	Eurasia
2009	2008	2007	77	Asia
2012	2008	2008	7	Methodology
2018	2009	2007	5	<i>Chlorophyceae</i>
2012	2009	2007	5	Oligocene
2010	2009	2008	5	Zinc
2018	2010	2006	12	Species Inventory
2020	2010	2004	6	<i>Apiaceae</i>
2018	2010	2004	6	<i>Ferula</i> sp.
2015	2011	2004	28	Aves
2019	2011	2009	11	Identification Method
2020	2011	2010	10	<i>Asteraceae</i>
2016	2012	2010	26	Regeneration
2018	2012	2012	16	<i>Hymenoptera</i>
2017	2012	2009	13	Anatolia
2020	2013	2010	17	<i>Quercus</i> sp.
2018	2013	2012	13	Population Abundance
2020	2013	2011	11	Population Structure
2017	2014	2012	24	<i>Fagus orientalis</i> L
2021	2014	2013	18	Biostratigraphy
2019	2015	2012	38	Fungi
2020	2015	2011	16	Paleoenvironment
2021	2015	2014	15	Crustacean

Continuation of Table 2) Topic trends of articles on Iranian biodiversity in the Scopus database during the years 1984-2025.

Year(Q3)	Year(Median)	Year(Q1)	Frequency	Term
2022	2016	2008	127	Middle East
2020	2016	2011	44	Evenness
2021	2016	2013	37	Population Distribution
2022	2017	2012	125	New Species
2020	2017	2013	111	DNA
2022	2017	2014	98	Genetics
2022	2018	2014	369	Animal
2021	2018	2013	100	Morphology
2021	2018	2012	80	Abundance
2022	2019	2014	1270	Biodiversity
2022	2019	2013	954	Iran
2022	2019	2015	185	Distribution
2022	2020	2015	262	Species Richness
2023	2020	2014	254	Taxonomy
2023	2020	2016	172	Phylogeny
2023	2021	2017	208	Conservation
2024	2021	2019	128	Climate Change
2023	2021	2017	113	Soil
2024	2022	2017	144	Ecosystem
2022	2022	2018	87	Fauna
2024	2022	2017	72	Remote Sensing
2024	2023	2020	22	Conservation Planning
2024	2023	2016	15	Azerbaijan Provinces
2024	2023	2019	12	Urbanization
2025	2024	2023	17	Ecosystem Services
2025	2024	2019	13	Organ Size
2025	2024	2022	11	Machine Learning
2025	2025	2025	11	Abiotic
2025	2025	2025	8	Biotic
2025	2025	2025	8	Forest Ecology

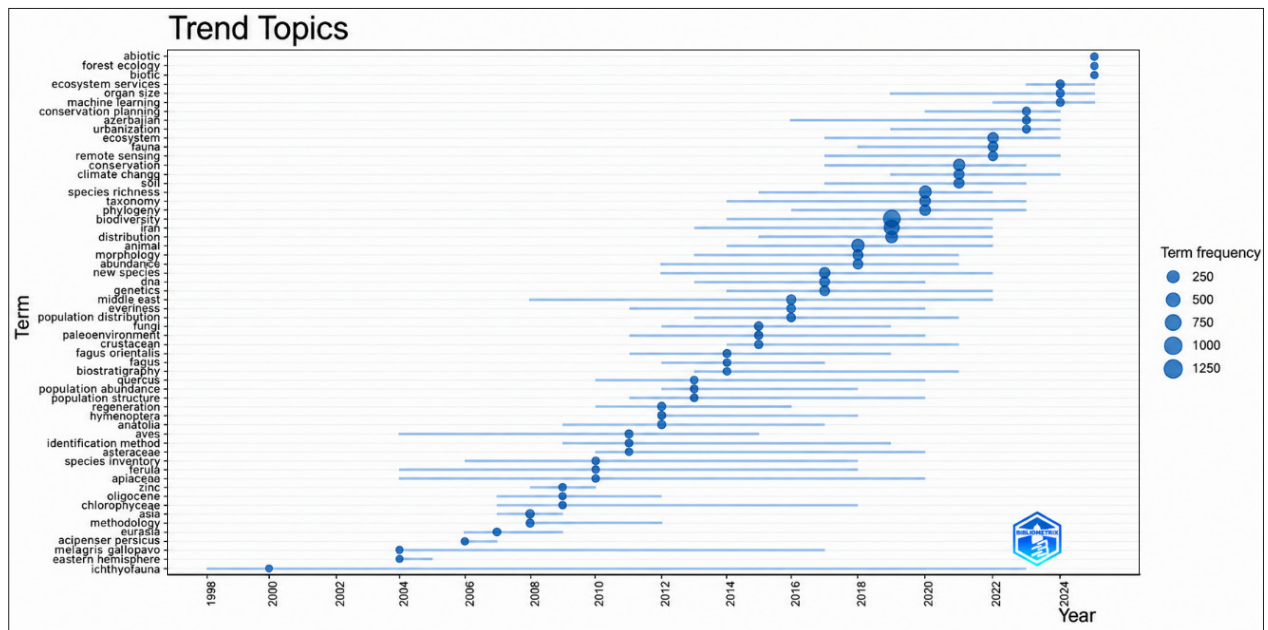


Figure 5) Topic trends of articles on Iranian biodiversity in the Scopus database during the years 1984-2025. (Source: Biblioshiny software)

range. Third generation: Hot and emerging topics (more recently emerging themes): Words whose median and Q3 fall within the last few years are considered emerging and hot topics. Species richness has the highest frequency in this generation. Taxonomy, conservation, ecosystem, climate change, and soil rank next in frequency. The words organ size, machine learning, ecosystem services, abiotic, biotic, and forest ecology have a Year (Q3) of 2025 and a Year (Median) of 2024 or 2025, indicating they are among the hot and emerging topics in this field.

Thematic Map

A cluster analysis of co-words in Iranian biodiversity revealed three topic clusters, shown in Figure 6.

As shown in Table 3, researchers used various indices, including network centrality (betweenness and closeness) and PageRank, in cluster analysis. In social network analysis, betweenness centrality measures how often a node lies on the shortest paths between other nodes, indicating its role in controlling information flow or acting as an intermediary

[28]. Closeness centrality indicates a node's proximity to all other nodes in the network and therefore reflects communication efficiency and accessibility [29]. Originally developed for ranking web pages, PageRank measures the centrality of a node by estimating the probability of a random walk reaching that node and gives more weight to links coming from higher-ranking nodes; in social network analysis, this index is widely used as a measure of prestige or influence in directed networks [30 - 31].

In this cluster, biodiversity, Iran, and species richness are among the most important words. This cluster primarily relates to biodiversity conservation and Forest Ecosystems in Iran. Table 4 shows the words in cluster 2. As shown in this table, animal, taxonomy, and distribution are among the most important words in this cluster. Overall, this cluster can be described as Biogeography and Animal Phylogeny.

An examination of the words in cluster 3, shown in Table 5, indicates that this cluster consists of 3 words, all of which deal with biodiversity issues from a marine perspective.

Table 3) Words in cluster 1, based on the Co-word map of Iran biodiversity research in the Scopus database from 1984 to 2025.

PageRank	Closeness	Betweenness	Cluster	Node
0.128	0.021	145.546	1	Biodiversity
0.122	0.021	132.568	1	Iran
0.037	0.021	9.813	1	Species Richness
0.027	0.02	3.869	1	Conservation
0.028	0.019	3.796	1	Ecosystem
0.019	0.019	1.491	1	Climate Change
0.017	0.018	1.111	1	Soil
0.02	0.018	2.15	1	Conservation Management
0.016	0.017	0.843	1	Vegetation
0.013	0.017	0.574	1	Zagros Mountains
0.016	0.018	1.442	1	Abundance
0.014	0.018	0.658	1	Water Quality
0.014	0.016	0.487	1	Wetland
0.018	0.017	1.152	1	Mazandaran Province
0.014	0.017	0.476	1	Temperature
0.01	0.014	0.105	1	Remote Sensing
0.01	0.014	0.246	1	Hyrcanian Forests
0.015	0.018	0.964	1	Environmental Factor
0.017	0.017	0.978	1	Forestry
0.013	0.017	0.443	1	Forest
0.013	0.017	0.52	1	Species Composition
0.014	0.015	0.272	1	Ramsar
0.013	0.018	0.459	1	Ecology
0.01	0.015	0.169	1	Endemic Species
0.008	0.014	0.086	1	Protected Area
0.014	0.016	0.496	1	Environmental Monitoring
0.007	0.014	0.042	1	Sustainability
0.008	0.014	0.063	1	Biomass
0.009	0.015	0.102	1	Evenness
0.011	0.016	0.345	1	Community Structure
0.008	0.015	0.099	1	Elevation
0.01	0.014	0.199	1	Forest Ecosystem

Table 4) Words in cluster 2, based on the Co-word map of Iranian biodiversity research in the Scopus database from 1984-2025.

Page Rank	Closeness	Betweenness	Cluster	Node
0.04	0.02	6.803	2	Animal
0.031	0.018	2.432	2	Taxonomy
0.028	0.02	3.993	2	Distribution
0.021	0.016	0.634	2	Phylogeny
0.021	0.017	1.35	2	Middle East
0.016	0.014	0.37	2	New Species
0.015	0.015	0.322	2	DNA
0.014	0.014	0.274	2	Morphology
0.016	0.014	0.151	2	Genetics
0.012	0.015	0.109	2	Fauna
0.012	0.014	0.154	2	Biogeography
0.017	0.016	0.642	2	Asia
0.015	0.016	0.494	2	Eurasia

Table 5) Words in cluster 3, based on the Co-word map of Iran biodiversity research in the Scopus database from 1984-2025.

PageRank	Closeness	Betweenness	Cluster	Node
0.014	0.014	0.308	3	Persian Gulf
0.015	0.015	0.236	3	Indian Ocean
0.012	0.014	0.077	3	Arabian Sea

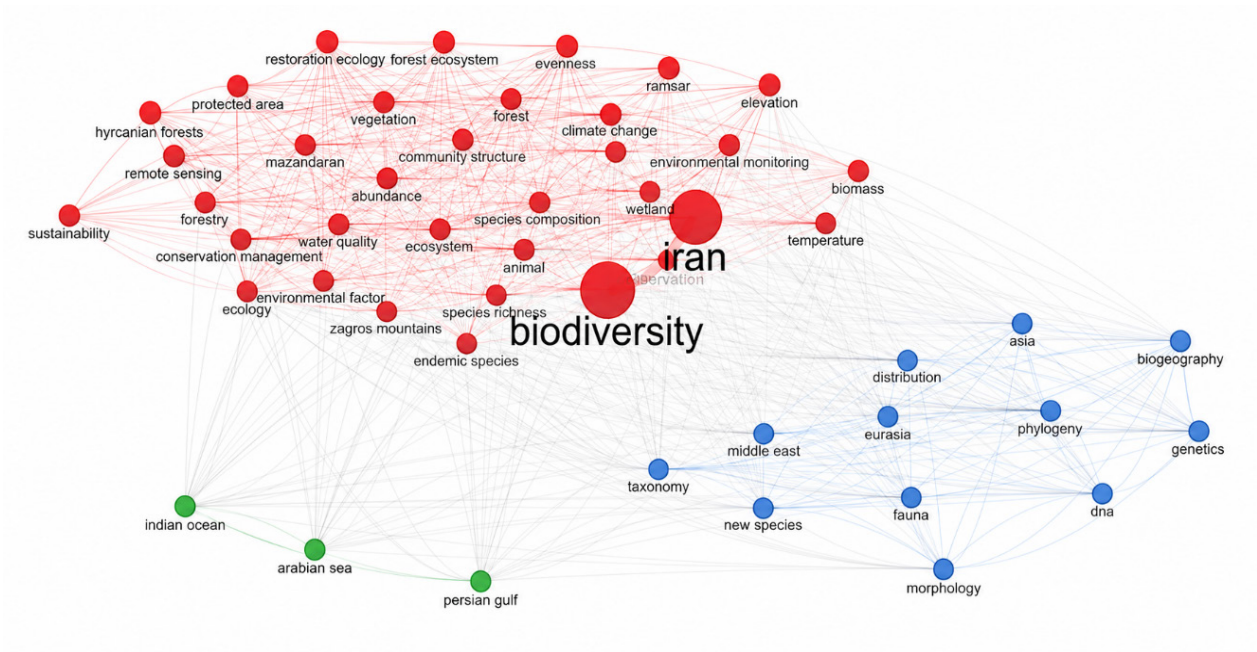


Figure 6) Co-word map of Iranian biodiversity articles in the Scopus database from 1984 to 2025. (Source: Biblioshiny software)

Discussion

This study aimed to explore Iranian biodiversity research using a scientometric approach and reveal thematic structures and trends in the field. The results indicated that 1758 documents related to this topic were published and indexed in Scopus. Analysis of publication trends in biodiversity research in Iran shows that these trends align with global patterns. Liu et al. (2011) showed that this field has grown explosively since the 1990s ^[14]. Publications, authors, and journals have also increased rapidly since the 1980s, followed by slower growth after 2008 ^[17]. Related subjects such as ecosystem services ^[18], biodiversity offsetting ^[19], and biodiversity loss ^[20] have also increased. However, Ali and Kumari (2016) reported a decline in the relative growth rate of publications alongside an increase in publication doubling time, indicating slower growth in research output ^[16].

The trend in article publication supports this development. Between 1984 and around 2006, the number of published articles was limited. However, since 2007, the publication rate has accelerated significantly, particularly after 2010. Scientific output peaked in 2021 and 2022, with about 180 articles published each year. Between 1984 and 2025, 1758 scientific papers were published across 702 journals, highlighting growing interest in biodiversity research across Iran's habitats. The 13.05% annual growth rate indicates that this field has steadily established itself as a key area of environmental and natural resources research in the country. With 4829 researchers and an average of 4.15 authors per article, these data clearly reflect the interdisciplinary and collaborative nature of biodiversity research. Given biodiversity's complexity and its close ties to ecology,

conservation biology, forestry, botany, zoology, genetics, geology, climatology, and other environmental sciences, expanding scientific collaborations in this area is inevitable ^[3].

These findings align with Ali and Kumari, who emphasize the prevalence of multi-authored articles in global biodiversity research ^[16].

Meanwhile, international participation in 38.74 percent of scientific productions indicates Iranian researchers' active involvement in global scientific networks. Iran's diverse habitats provide important contexts for biodiversity research. The dataset's relatively high level of international collaboration (38.74%) may reflect international interest in these contexts. However, the present study does not directly assess the factors underlying collaboration. The Elsevier (2024) research report provides additional contextual information on the global biodiversity research landscape and emphasizes that biodiversity research is inherently interdisciplinary ^[32]. It has gained an international reputation and holds a significant position in citations and influence on environmental policies, surpassing many other scientific fields.

Analysis of publication sources reveals that Iranian biodiversity research over the past five decades has centered on two complementary areas: basic taxonomic studies and applied ecological and conservation research. Much of this output has appeared in specialized taxonomy journals, such as *Zootaxa*, *Zoology in the Middle East*, *Taxonomy and Biosystematics*, and the *Journal of Insect Biodiversity and Systematics*. This indicates that species identification, description, and classification remain foundational to advancing biodiversity knowledge in Iran.

This trend aligns with Iran's biogeographical features, including high habitat diversity, species richness, and many endemic species. It underscores the importance of ongoing fundamental research to enhance the country's biological knowledge [2]. Conversely, Stork and Astrin (2014) highlighted a significant geographical mismatch between research efforts and the global distribution of biodiversity [17].

Along with this trend, the increasing number of articles published in journals such as "Environmental Monitoring and Assessment", "International Journal of Environmental Science and Technology", "Journal of Rangeland Science", and "Scientific Reports" reflects a gradual shift in research focus. This shift moves from purely descriptive studies to ecological research, environmental monitoring, ecosystem management, and assessments of climate change and land-use impacts. This evolution indicates that Iran's biodiversity research, while still emphasizing fundamental studies, is increasingly addressing practical issues and emerging environmental challenges. Furthermore, Fazeli-Varzaneh et al. highlighted in their scientometric analysis of forestry research in the Middle East that publishing in esteemed international journals, along with developing scientific collaborations, significantly increases citations, enhances scientific quality, and broadens research impact. This trend is evident in Iranian biodiversity research [21]. Recent scientometric studies conducted in Iran support this trend. According to Fazeli-Varzaneh et al. (2021), Sagheb-Talebi et al. (2019), Fazeli-Varzaneh (2020), and Fazeli-Varzaneh et al. (2021), Iranian research on natural resources and the environment is increasingly shifting away from specialized,

narrow topics [21,33-35]. Instead, it is adopting interdisciplinary, applied, and problem-oriented approaches. The primary goal of this shift is to develop solutions to protect, manage, and sustainably use natural resources.

A review of the most highly cited documents among the retrieved records shows that the literature draws on works from diverse scientific domains, including biogeography, ecology, evolutionary biology, earth sciences, and environmental studies. The citation counts reported in this analysis reflect global citations. They should not be interpreted as citations from the retrieved corpus or as direct evidence of influence on Iranian biodiversity research. Notably, Kimura and Watanabe (2001) [36], Harzhauser et al. (2007) [37], and Bahram et al. (2012) [38] were among the most globally cited documents in the retrieved dataset. These citation patterns therefore reflect the broader citation impact of the documents in the retrieved literature rather than their direct contribution to the theoretical or methodological development of biodiversity research in Iran.

These studies indicate that Iranian researchers, in line with global research trends, have used internationally accepted theories and methods to examine biodiversity patterns, ecological processes, and evolutionary relationships. Furthermore, the inclusion of two articles by Noroozi et al. (2008, 2018) among the most cited documents highlights the significance of biogeographic studies and the identification of biodiversity hotspots in Iran and the Irano-Anatolian region. This suggests that research on Iranian ecosystems has become an influential source in the international literature.

Extensive citations of studies by Riehl (2013

[39], Ghasemi Pirbalouti (2013) [40], Pimenov (2004) [41], Amiraslani (2011) [42], and Augustinos (2011) [43] suggest that research on Iranian biodiversity has leveraged the scientific expertise across various disciplines, including botany, zoology, genetics, climatology, agriculture, geography, and geology. This thematic diversity reflects the field's interdisciplinary nature, indicating that understanding biodiversity patterns and processes requires integrating knowledge from multiple areas. From a scientometric perspective, this pattern reflects a gradual shift in Iranian biodiversity research—from primarily relying on international resources to engaging in two-way interaction with the global literature. In this evolution, researchers have not only used international theoretical and methodological frameworks, but some studies on Iranian ecosystems have also become reference sources for researchers in other countries. The observed publication and thematic patterns provide evidence of the expansion and diversification of Scopus-indexed biodiversity research in Iran. The findings of this study are consistent with the results reported by Stork and Astrin, Ali and Kumari, as well as an Elsevier report, which suggest that the development of a scientific discipline can be reflected in researchers' active participation in producing reference knowledge and contributing to the international scientific literature [15-17, 32].

Analysis of Keywords and Concepts

An analysis of commonly used terms and vocabulary reveals that the conceptual framework of Iranian biodiversity research has evolved. Initially focused on fundamental concepts like "biodiversity," "animal and fauna," "species richness," "taxonomy," "conservation," "ecosystem," and "climate

change,"

These findings align with Azra et al. [44] on marine biodiversity and climate change, as well as the Elsevier report [32], which highlights the growing global focus on conservation, ecosystem services, policymaking, and sustainable management. Despite recent advancements, the analysis of the most frequently used terms reveals that several emerging concepts in global literature—such as "ecosystem services," "functional biodiversity," "conservation genomics," "nature-based solutions," "long-term monitoring," and "ecosystem restoration"—still do not hold a significant position in the framework of Iranian biodiversity research. This indicates that while Iranian research has aligned with global trends in core concepts, considerable potential remains to explore new areas of knowledge and pursue future research opportunities.

Time Trend and Conceptual Evolution of Research Topics

Trends in key-term occurrence show that the conceptual structure of Iranian biodiversity research has followed a gradual yet accelerating progression over the past four decades. Until the early 2000s, most concepts appeared infrequently, and their growth trends remained uniform. However, after 2008, keyword occurrences increased noticeably, and this trend continued to accelerate through 2025. This pattern suggests that the field's growth is not solely due to more published articles; the conceptual scope of the research has also expanded substantially alongside this rise in scientific output. This expansion reflects the field's growing thematic breadth and diversification.

Among all the keywords analyzed, the term

"Iran" has exhibited the highest growth rate, significantly outperforming other concepts in the final years of the study period. This trend indicates an expansion of Scopus-indexed biodiversity research associated with Iran, along with increasing representation of conservation-, monitoring-, and ecosystem-related themes. While these patterns are consistent with growing research attention to these aspects of biodiversity, they should not be interpreted as direct evidence of changes in researchers' underlying interests or motivations. Additionally, the term "Biodiversity" has shown a stable, upward trajectory, solidifying its role as a central component of the field's conceptual framework. The simultaneous growth of this concept, along with terms such as "Conservation," "Species Richness," "Distribution," "Ecosystem," and "Taxonomy," indicates a shift in Iranian biodiversity research towards analyzing distribution patterns, species richness, ecosystem functioning, and biodiversity protection. Furthermore, the rise of the term "Animal" and the increased frequency of concepts such as "Water Quality," "Distribution," and "Ecosystem" reflect a broader scope of studies, moving from merely describing species to examining ecological processes, habitat quality, and sustainable ecosystem management. This shift aligns with Stork and Astrin ^[17]. Although the term "animal" emerged as a prominent, growing keyword in studies of Iran's biodiversity, it did not appear among the frequently occurring terms identified in Stork's study. This discrepancy may reflect a greater emphasis on faunal studies in Iranian biodiversity research. It could also stem from differences in geographical scope, thematic focus, and dataset composition (i.e., citation databases).

The temporal distribution of keywords in Iranian biodiversity research reveals a clear thematic shift over time. Early studies primarily focused on taxonomy, faunal and floristic surveys, and biogeography, emphasizing species identification, distribution, and biological documentation. Terms like "ichthyofauna" persisted, indicating that these classical subjects continued to support later ecological and conservation-oriented research rather than being entirely replaced. During the middle period, interest grew in ecological structure, regeneration, community organization, and regional perspectives, highlighted by keywords such as "Middle East," "evenness," "fungi," and "*Fagus orientalis* L." More recent research has increasingly focused on species richness, conservation, ecosystems, climate change, soil, and forest ecology. The emergence of terms related to machine learning, ecosystem services, and both biotic and abiotic factors suggests a significant move toward data-driven, interdisciplinary, and management-relevant research. Overall, the field has shifted from descriptive, species-based studies to ecosystem-oriented, conservation-focused, and analytical approaches, while still recognizing taxonomy as an essential scientific foundation.

The Elsevier report ^[32] provides additional contextual information. It also supports this global perspective by highlighting the critical roles of conservation, ecosystem services, climate change, sustainable management, and new technologies in the future of biodiversity research. Temporal keyword trends show that biodiversity research in Iran has increasingly become ecosystem-oriented, conservation-focused, and problem-driven, broadly aligning

with global research directions. Greater use of data-driven methods and advanced analytical tools could further strengthen this alignment.

The identified research themes, including machine learning, ecosystem services, and conservation planning, partly align with recent conservation and natural-resource research priorities in Iran. The geographic distribution of studies also overlaps with major ecological regions such as the Hyrcanian forests, Zagros, and Irano-Turanian zone. However, because this study is scientometric in scope, it did not include ecological indicators such as species richness, IUCN Red List coverage, and protected-area representation, which future research should consider.

Co-Occurrence Clusters and Knowledge Structure in Biodiversity Research

The co-occurrence network analysis shows that Iranian biodiversity research comprises several interconnected thematic areas. The close relationships among these areas indicate that biodiversity research in Iran extends across different but related topics rather than being limited to a single disciplinary perspective. Concepts such as biodiversity, Iran, species richness, animals, conservation, ecosystems, distribution, and conservation management connect these areas. This structure aligns with Stork and Astrin ^[17] and Ali and Kumari ^[16], who identified biodiversity, conservation, and ecosystems as central components of global biodiversity research. The network centers on biodiversity, species, ecosystems, forests, habitats, and conservation, highlighting the importance of biodiversity conservation and forest ecosystems, particularly the Hyrcanian forests. At the same time, animal-related

concepts, including taxonomy, distribution, and phylogeny, form another important part of the research structure, reflecting a focus on biogeography and animal phylogeny. Notably, previous scientometric studies of biodiversity have not given animals the same level of attention ^[14–17]. The third thematic area concerns marine biodiversity and includes research on the Persian Gulf, Gulf of Oman, and Caspian Sea, including aquatic species, fisheries, coastal habitats, and pressures such as pollution, overexploitation, habitat degradation, and climate change. Taken together, the three thematic areas show that biodiversity research in Iran encompasses terrestrial conservation and forest ecosystems, biogeography and animal phylogeny, and marine and coastal biodiversity. Although these areas are connected within the overall network, stronger connections among them could further integrate biodiversity research in Iran. Taken together, the co-word clusters and temporal topic trends provide evidence of an evolving conceptual structure in Iranian biodiversity research. While taxonomic, faunal, biogeographic, and evolutionary themes remain important, the co-occurrence structure also shows a strong ecological and ecosystem-oriented dimension, including conservation, protected areas, forest ecosystems, environmental monitoring, restoration, and sustainability. The temporal distribution of topics further suggests that conservation- and ecosystem-related themes have become increasingly visible alongside established species- and taxonomy-oriented research. Thus, the field's evolution appears to reflect a broadening of thematic emphasis rather than a complete replacement of earlier research traditions.

Conclusion

Using scientometric methods, this study provides a comprehensive overview of the evolution of biodiversity research in Iran from 1984 to 2025. The trends suggest a shift from predominantly descriptive, species-focused studies to more interdisciplinary, ecosystem-oriented, and conservation-related themes. The increase and thematic diversification of Scopus-indexed publications suggest broader research activity in the field. However, these patterns should not be interpreted as a direct measure of the overall maturity of biodiversity research in Iran. Meanwhile, the findings indicate that taxonomy, floristics, and biogeography studies remain the foundational pillars of knowledge production. Over time, these areas have increasingly integrated with research relating to biodiversity conservation, restoration ecology, land-use change, ecosystem management, and climate change.

The study also shows that advances in biodiversity knowledge in Iran have been supported by collaboration among universities, research centers, and domestic and international scientific networks. These partnerships have improved research quality, facilitated knowledge transfer, and connected Iranian research with broader trends in global biodiversity science. However, the results also point to considerable opportunities for further progress through new technologies and approaches, which could be an important focus for future research. The findings further suggest that changes in biodiversity research in Iran cannot be explained simply by the growth in scientific output. Rather, they reflect the gradual development of a broader knowledge base that has

increasingly extended beyond identifying and documenting biodiversity to addressing conservation, sustainable ecosystem management, and providing scientific support for environmental policies. To sustain this progress, it will be essential to balance basic and applied research, strengthen data infrastructure, foster scientific collaboration, and effectively use new technologies and approaches. Ultimately, the future of biodiversity research in Iran relies more on the scientific community's ability to integrate foundational knowledge with cutting-edge technologies, promote interdisciplinary research, and produce reliable evidence to inform major decision-making processes. This approach will not only strengthen Iran's position in the global biodiversity literature but also enhance its role in protecting the country's natural resources and achieving sustainable development goals.

Rather than introducing a new scientometric method, this study provides an empirical, national-scale map of Iran's biodiversity research landscape. The identified publication trends, thematic clusters, and emerging topics provide a baseline for understanding how research interests have developed and diversified over time and may inform future research agendas and evidence-based priority setting in biodiversity research. Overall, the co-word clusters and temporal topic trends suggest an expanding conceptual structure of Iranian biodiversity research, in which established taxonomic and biogeographic themes increasingly coexist with broader ecological, ecosystem, conservation, and sustainability-oriented research.

Study Limitations

A significant limitation of this study is

its reliance on the Scopus database. The dataset includes only biodiversity research publications indexed in Scopus, meaning it does not provide a comprehensive view of all biodiversity research conducted in Iran. Notably, this dataset excludes research published in journals not indexed in Scopus—especially many Iranian domestic journals that publish in Persian. This language and database-coverage limitation may underrepresent locally published research, particularly work published primarily in Persian.

Moreover, the relatively low number of publications indexed before approximately 2008 should not be interpreted as evidence of a lack of biodiversity research in Iran. This trend may partly reflect changes in Scopus's historical coverage, retrospective indexing practices, journal selection, language inclusion, and the availability and completeness of bibliographic metadata for earlier works. Therefore, the temporal trends identified in this study should be viewed as changes in the volume of biodiversity research indexed in Scopus, rather than as an accurate measure of Iran's total scientific output in this field.

Because the study was a descriptive scientometric analysis, we did not conduct formal inferential testing or systematic sensitivity analyses. Consequently, interpret the reported temporal and network patterns as descriptive characteristics of the retrieved and processed dataset rather than statistically generalized effects. Another limitation concerns the potential influence of the search strategy and database indexing on the observed keyword patterns. Although experts iteratively developed and reviewed the search query, its relatively broad contextual terms may have retrieved records from adjacent fields, particularly paleobiological

and paleoenvironmental research. Therefore, interpret the temporal prominence of terms such as *Oligocene* and *biostratigraphy* cautiously. Similarly, excluding the exact phrase "*genetic diversity*" did not exclude broader genetics- or DNA-related research, which may explain the presence of terms such as *genetics* and *DNA* in the keyword network. Consequently, the observed keyword trends should be understood as characteristics of the retrieved Scopus-indexed corpus, not as definitive evidence of underlying thematic evolution across the entire biodiversity research field in Iran.

Another limitation is using an institutional research report as a contextual source. The Elsevier (2024) report provides additional context on the global biodiversity research landscape and is based on bibliometric data from Scopus and SciVal. However, as an institutional report rather than a peer-reviewed research article, its findings should be interpreted as contextual evidence rather than as a substitute for evidence from the peer-reviewed literature.

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AI Use Declaration: The authors utilized Grammarly AI (browser extension) on July 8–12, 2026, solely to refine the English language, clarity, and readability throughout the entire manuscript. As mentioned in the methodology section, we also used Scopus AI and ChatGPT to structure the query. In response to the reviewers' comments, we also used ChatGPT to improve the quality of the figures. The authors reviewed and edited the output and take full responsibility for the publication's content.

References

1. Akhani H., Djamali M., Ghorbanalizadeh A., Ramezani E. Plant biodiversity of Hyrcanian relict forests, N Iran: an overview of the flora, vegetation, paleoecology and conservation. *Pakistan J. Bot.* 2010; 42(1): 231-258.
2. Noroozi J., Talebi A., Doostmohammadi M., Manafzadeh S., Asgarpour Z., Schneeweiss G.M. Endemic diversity and distribution of the Iranian vascular flora across phytogeographical regions, biodiversity hotspots and areas of endemism. *Sci. Rep.* 2019; 9(1):12991.
3. Noroozi J., Talebi A., Doostmohammadi M., Rumpf S.B., Linder H.P., Schneeweiss G.M. Hotspots within a global biodiversity hotspot - areas of endemism are associated with high mountain ranges. *Sci. Rep.* 2018; 8(1):10345.
4. Kazemi S.M., Hosseinzadeh M.S. High Diversity and Endemism of Herpetofauna in the Zagros Mountains. *ECOPERSIA* 2020; 8(4):221-229.
5. Ghanbarifardi M. Habitat Heterogeneity Influences Intertidal Fish Biodiversity and Ecological Functions in Chabahar County, Sea of Oman. *ECOPERSIA* 2025;13(4):429-439.
6. Noori S., Zahiri R., Yusefi G.H., Rajabizadeh M., Hawlitschek O., Rakhshani E., Husemann M., Rajaei H. Patterns of Zoological Diversity in Iran: A Review. *Diversity*. 2024; 16(10):621.
7. Hood W.W., Wilson C.S. The Literature of Bibliometrics, Scientometrics, and Informetrics. *Scientometrics*. 2001; 52(2):291-314.
8. Heidari G. Epistemological assumptions of scientometrics. *Libra Inf. Sci.* 2011; 14(1):71-96.
9. Chen C. Science Mapping: A Systematic Review of the Literature. *J. Data Inf. Sci.* 2017; 2(2):1-40.
10. Zupic I., Čater T. Bibliometric Methods in Management and Organization. *Organ. Res. Methods*. 2015; 18(3):429-472.
11. Zandi Ravan N., Davarpanah M., Fattahi R. Review of Science Map Visualization and its Methodology. *Scientometr. Res. J.* 2016; 2(1): 57-76.
12. Cobo M.J., López-Herrera A.G., Herrera-Viedma E., Herrera F. Science mapping software tools: Review, analysis, and cooperative study among tools. *J. Am. Soc. Inf. Sci. Technol.* 2011; 62(7):1382-1402.
13. Ahmadi H., Osareh F. Co-word Analysis Concept, Definition and Application. *Librariansh. Inf. Organ. Stud.* 2017; 28(1):125-145.
14. Liu X., Zhang L., Hong S. Global biodiversity research during 1900-2009: a bibliometric analysis. *Biodivers. Conserv.* 2011; 20(4):807-826.
15. Ali H., Adithya Kumari A. Biodiversity: a scientometric analysis of publication output from India during 2003-2012. *J. Adv. Library Sci.* 2015; 2(2):41-47.
16. Ali H., Adithya Kumari H. Scientometric analysis of world biodiversity literature. *Int. J. Library Inf. Stud.* 2018;8(1):261-271.
17. Stork H., Astrin J.J. Trends in Biodiversity Research: A Bibliometric Assessment. *Open J. Ecol.* 2014;4(7):354-370.
18. Gangahagedara R., Subasinghe S., Lankathilake M., Athukorala W., Gamage I. Ecosystem Services Research Trends: A Bibliometric Analysis from 2000-2020. *Ecologies*. 2021;2(4):366-379.
19. Yu S., Cui B., Xie C., Man Y., Fu J. Bibliometric Review of Biodiversity Offsetting During 1992-2019. *Chin. Geogr. Sci.* 2022;32(2):189-203.
20. Tan Y.L., Yiew T.H., Habibullah M.S., Chen J.E., Mat Kamal S.N.I., Saud N.A. Research trends in biodiversity loss: a bibliometric analysis. *Environ. Sci. Pollut. Res.* 2023; 30(2): 2754-2770.
21. Fazeli-Varzaneh M., Bettinger P., Ghaderi-Azad E., Kozak M., Mafi-Gholami D., Jaafari A. Forestry research in the Middle East: a bibliometric analysis. *Sustainability*. 2021;13(15):8261.
22. Hadi M., Hashemkhani M., Iravani E. The trend of scientific research analysis on climate change in Iran. *Iran. J. Health Environ.* 2022; 15(2):361-378.
23. Yarizanganeh M., Mostafavi I., Dastar Y. Content Analysis and Evaluation of Iranian Researchers' Scientific Outputs of Climate Change Subject Area: A Scientometric Study. *Clim. Change Res.* 2025;6(23):1-20.
24. Rahimi S., Karmi T. Cluster Analysis and Mapping Thematic Trends in the Environmental Studies: A Scientometric Study. *Geography Environ. Sustain.* 2025; 15(2): 89-105.
25. Akyıldız G. K., Altındağ, A., Tavşanoğlu, Ü. N. Recent advances in freshwater zooplankton in a conservation hotspot: Türkiye case. *Hydrobiolo-*

- gia. 2025; 852(10): 2581-2594.
26. Al-Mutairi K.A. From desert margins to global insights: Floristic diversity and conservation strategies in the arid regions of Tabuk and Khulais, Saudi Arabia - a bibliometric and ecological synthesis. *Front. For. Glob. Change*. 2025; 8(1):1669742.
27. Aria M., Cuccurullo C. *Bibliometrix*: An R tool for comprehensive science mapping analysis. *J. Informetr.* 2017;11(4):959-975.
28. Freeman L.C. A Set of Measures of Centrality Based on Betweenness. *Sociometry*. 1977; 40(1):35-41.
29. Freeman L.C. Centrality in social networks: conceptual clarification. *Soc. Netw.* 1978; 1(3):215-239.
30. Page L., Brin S., Motwani R., Winograd T. The PageRank citation ranking: Bring order to the web. In: *Proc. of the 7th International World Wide Web Conf.-1998* [Internet]. 1999 [cited 2026 June 11].
31. Brin S., Page L. The anatomy of a large-scale hypertextual Web search engine. *Comput. Netw. ISDN Syst.* 1998; 30(1-7):107-117.
32. Biodiversity Research in 2024: A Global Perspective with a Focus on Latin America [Internet]. *Elsevier*; 2024 [cited 2026 July 8].
33. Sagheb-Talebi K., Attar F., Sadeghzadeh Hallaj M.H., Masoum Tamimi M. Citation analysis of articles in the Iranian Journal of Forest and Poplar Research from 2005 to 2011. *Iran. J. For. Poplar Res.* 2019; 27(3):311-327.
34. Fazeli-Varzaneh M. An investigation of the literature of the Hyrcanian forests in Web of Science based on scientometric indicators. *Iran. J. For. Poplar Res.* 2020; 28(1): 97-109.
35. Fazeli-Varzaneh M., Shahmirzadi T., Masoum Tamimi M., Attar F. Citation analysis of the Iranian Journal of Forest and Poplar Research in the Scopus database. *Iran. J. For. Poplar Res.* 2021; 29(1):1-12.
36. Kimura H., Watanabe Y. Oceanic anoxia at the Precambrian-Cambrian boundary. *Geology*. 2001; 29(11):995-998.
37. Harzhauser M., Kroh A., Mandic O., Piller W.E., Göhlich U., Reuter M., Berning B. Biogeographic responses to geodynamics: a key study all around the Oligo-Miocene Tethyan Seaway. *Zool. Anz.* 2007;246(4):241-256.
38. Bahram M., Pölme S., Köljal U., Zarre S., Tedersoo L. Regional and local patterns of ectomycorrhizal fungal diversity and community structure along an altitudinal gradient in the Hyrcanian forests of northern Iran. *New Phytol.* 2012; 193(2): 465-473.
39. Riehl S., Zeidi M., Conard N.J. Emergence of agriculture in the foothills of the Zagros Mountains of Iran. *Science*. 2013; 341(6141):65-67.
40. Pirbalouti A.G., Hashemi M., Ghahfarokhi F.T. Essential oil and chemical compositions of wild and cultivated *Thymus daenensis* Celak and *Thymus vulgaris* L. *Ind. Crop. Prod.* 2013; 48(1):43-48.
41. Pimenov M.G., Leonov M.V. The Asian Umbelliferae biodiversity database (ASIUM) with particular reference to Southwest Asian taxa. *Turk. J. Bot.* 2004; 28(1):139-145.
42. Amiraslani F., Dragovich D. Combating desertification in Iran over the last 50 years: an overview of changing approaches. *J. Environ. Manage.* 2011; 92(1):1-13.
43. Augustinos A.A., Santos-Garcia D., Dionyssopoulou E., Moreira M., Papapanagiotou A., Scarvelakis M., Doudoumis V., Ramos S., Aguiar A.F., Borges P.A., Khadem M., Latorre A., Tsiamis G., Bourtzis K. Detection and characterization of Wolbachia infections in natural populations of aphids: is the hidden diversity fully unraveled? *PLOS ONE*. 2011; 6(12): e28695.
44. Azra M.N., Noor M.I.M., Rasdi N.W., Ghaffar M.A. A Scientometric review of the impacts of global climate change towards marine biodiversity research: The Rise and Progress. *IOP Conf Ser: Earth Env. Sci.* 2022; 987(1):1-11.