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Scient metrics analysis of mangrove studies from 1980 to 2020

Abstract

Mangroves are complex transition ecosystems studied and affected by human activities.. This work sought information on articles in scientific journals related to environmental impacts and their forms of management and restoration and those focused on biodiversity conservation. To answer this question, we developed this work based on a scient metric survey of production with a focus on impacts and environmental and Biodiversity responses on mangroves in the last forty years (1980 to 2020), comparing mainly the global scientific production and the production in America, listing areas of research concentration, and journal, period, country and region of publication of papers. With this survey, we could observe a standardization of the research classification area and publication periods, although checking the journals found a great variety of these. As for the regionalization of studies, we could observe that, globally, the region that most contributes to the advancement in this theme is Asia; however, the country that collaborates the most, in isolation, is the United States. Although there is a diversification regarding the specific theme, the scientific production on mangroves with an environmental focus and in Biodiversity followed a global pattern in the studied period.

Keywords: environment, biodiversity, environmental impacts, america, conservation

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Introduction

Mangroves are coastal ecosystems located in tropical and subtropical regions.[1] They present a great wealth of Biodiversity and nutrients and act as natural protection barriers in coastal areas.[2] It has an essential function in the cycling of nutrients, mainly nitrogen (N), including improving the quality of wastewater.[3] Furthermore, they are responsible for naturally disenchanting and recycling considerable amounts of carbon, playing an important role in controlling climate change.[4]

However, there are environments in danger due to deforestation and changes in sea level.[4] Approximately 35% of the global mangrove coverage suffered high impact and devastation due to human actions until the 2000s.[5] This fact is related to its establishment in the most inhabited regions of the World.[6] There is still an inestimable reduction related to the occupation rates of the coastal region expected for the next century.[5] One of the main factors that lead to this loss is aquaculture farms[7] and domestic sewage, directly related to high amounts of phosphorus (P) contained in its effluents—making it possible to associate this fact with the eutrophication of the soil, due to this enrichment of nutrients. This process provides a boom of bacteria and cyanophytes, limiting oxygen availability in the environment, causing the difficulties of assimilation and availability of nutrients by the present microbiota.[8] These high rates of nutrients, mainly N and P, and organic matter can functionally affect local natural communities. It impacts even as resources of exchange of nutrients between the biosphere components. Not only as long-term highs of nutrients but also the characteristics of physical-chemical factors in water are decisive for the functional activity of these ecosystems. Changes in salinity changes, dissolved oxygen, and regulated pH in the mangrove productivity levels. Moreover, these control the availability of nutrients and organic matter for the surrounding environments.[9]

Currently, mangroves have been an essential subject in the World about environmental responses, mainly related to anthropic interference.[3,6,9-14] In addition to studies of an ecological approach, it is relating the complexity and interactions occurring in those ecosystems, which have been an expressive front of research since the first record of scientific publication about mangroves, "*Mangroves in the New World*," published in Nature in 1945 by PRESTON[15] to the present. However, there is still no reference that lists the main themes and study approaches of an environmental nature regarding mangroves or the frequency and period of these productions. To fill this gap, we analyzed the temporal space relationships of publications on mangroves in the last four decades (1980 to 2020), whose focus centered on preserving or impacting this biome and its Biodiversity—together pronounced a comparison of the global data with the specific data of America, to verify if the regionalized production follows the profiles of the global production. To verify whether there is a standardization in the subject of study and periods of publication.

Methods

For the development of this study, a scient metric approach was adopted, treating a metric commonly used to quantify the production of scientific publications and the spread of knowledge.[16,17] We used the search platform Web Of Science[1] to survey scientific productions on mangroves with an environmental focus. We opted for this search platform due to its prior analysis of the publications, making it possible to obtain graphs and sheets containing titles, years of publication, authors, publication journal, DOI, research area, and other information.

We assembled two clusters of data, the first focusing on environmental effects (*Environment*) and the second about biodiversity (*Biodiversity)*. To this end, the terms "*mangrove*" was used as the title and "*environmental*," "*effect,*" and "*impact*" as topics. In the second group, using the previous approach, we added the topic "*biodiversity*."Both datasets were divided into two subsets, one with a global focus named *World*, and the other focusing on studies carried out in the American continent, also using the "*America*" index in

the search. All search groups, all terms were indexed by the "and" code so that all papers obtained must present the terms determined. We restricted the survey to the last four decades, from 1980 to 2020, and only publications in the "*Articles*" category. We used the "All Databases" option for a broader search range, thus covering the Web Of Science Core Collection and Derwent Innovations Index, KCI- Korean Journal Database, Russian Science Citation Index, and SciELO Citation Index. We used data about: i) Source of study (Countries/Regions); ii) Date of publication (Source Titles); iii) Publication Years; iv) Where the papers were published.

All data treated in this study were extracted directly from the Web Of Science platform. Such a mechanism has an algorithm that calculates the frequency of publications for each of the interest categories. It is noteworthy that this algorithm includes the same publication in different groups of a category (e.g. the study developed in the Bahamas by the University of Florida. It counts as 1 Bahamas and 1 Florida). After obtaining this data, we transformed it into CSV files. (comma separated values), using the Google Sheets online platform. These documents were transferred to the CorText[2] platform to extract other data such as the list of resulting topics, applying the "List Builder" function.

Results and discussion

Web of science

We found 11,143 publications containing "mangrove" in the title. When applying the words "environmental," "impact," and "effect" as topics, we obtained 507 publications in the category "article," whose set we call Environment (E), and used in the analysis with a global focus. With this survey, we observed that a small part of the scientific production of the last forty years (approximately 5%) has a focus on environmental impacts and effects. These studies began in 1987, forty-two years after the first record of a scientific article study on mangroves. Around the World, the production of mangroves' environmental studies began more effective in2007 (12 articles), and in 2019, "ENVIRONMENTAL IMPACT" become the most present theme, with 59 publications (Figure 1). The indexer "*America*" resulted in 113 articles, just over 1% of the total publications on mangroves, and approximately 22.2% of the publications with an environmental focus (*Environment-America*). The first record is dated 1988, developed at Costa Rica by Universidad Costa Rica. Then there is a publications gap, and from 1992 onwards, there is notable growth in production on the continent, reaching its peak in 2019 when were registered the publication of 12 scientific articles (Figure 1).

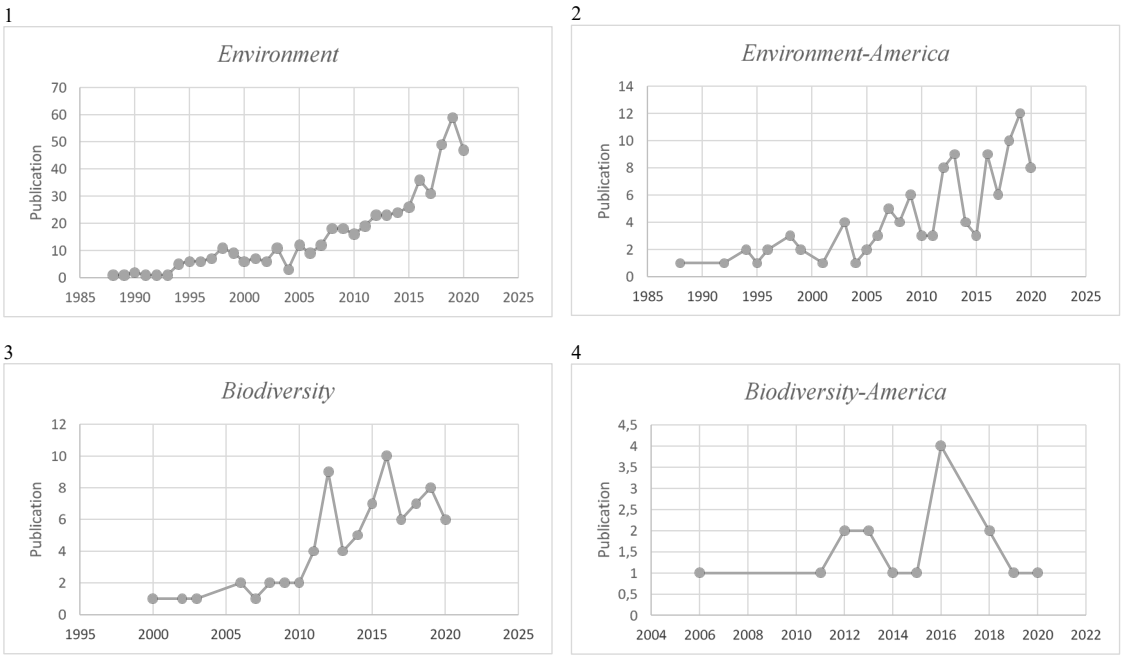

Figure 1 Annual distribution of paper related to mangroves to each corpus studied, between 1980 to 2020. 1 – *Environment;* 2 - *Environment-America*; 3 – *Biodiversity* e 4 – *Biodiversity-America.*

We restricted the "*Environment"* data set with the inclusion of the "*biodiversity*" indexer, obtaining a total of 78 articles, with the first article published in 2000 (Figure 1) by Skilleter and Warren from the University of Queensland, Australia. This group has a less homogeneous distribution over the decades, with ten publications in 2016. We restricted the "*Biodiversity*" data set with the "*America*" indexer, shown 16 articles. The first record was on isolation, in 2006 performed by Delabie et al.,[18] in Brazil. The second was published in 2011, in Brazil, when the production begins to show growth, with the peak reached in 2016. As noted in the chronological analysis, Brazil is the country that most collaborates for this production in America (11 of the 16 studies).

Figure 2 shows high publication concentration in Asia, where occurs the largest mangrove areas. However, United States is the country with immense productivity (Figure 3), mainly developing public preservation policies in Florida forests and the Gulf of Mexico.[19,3,20] When we look at the countries with the most significant influence on scientific production, we realize that the United States and Brazil cooperate with more than 5% of scientific production for all. As such, two of the most important countries in mangrove research on a global scale. Figure 3 shows a graph with the countries individually responsible for more than 5% of the total scientific production.

We found 83 knowledge areas for the "Environment" data set,while for Environment-America, 66 research areas. In the'

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Biodiversity' set, the number of areas was reduced to 60 research areas (Figure 4). Finally, for "Biodiversity-America," this result was even lower, for 32 knowledge areas in total, all of which represented more than 5% of the published articles; however, 11 of them with only 1 article. We could observe that the area of greatest concentration was "Environmental Sciences Ecology" (E-98.22%; EA-98%; B-93.59%; BA-94% of publications), and for the set data involving "biodiversity" as an indexer, this area falls to second place, with "Biodiversity Conservation" being the area of greatest concentration (B-94.87%; BA-100% of publications).We can see that there is a certain similarity regarding the publication periods and the concentration areas of studies with an environmental focus, produced in America with the rest of the World. We observed similar behavior in the scientific movement about Biodiversity with an environmental focus on mangroves in the World and America. However, when we look at the four data sets together, we can see some differences between the two approaches: environmental and biodiversity. For the second, the publication starts later, and the peak of publications occurs earlier.

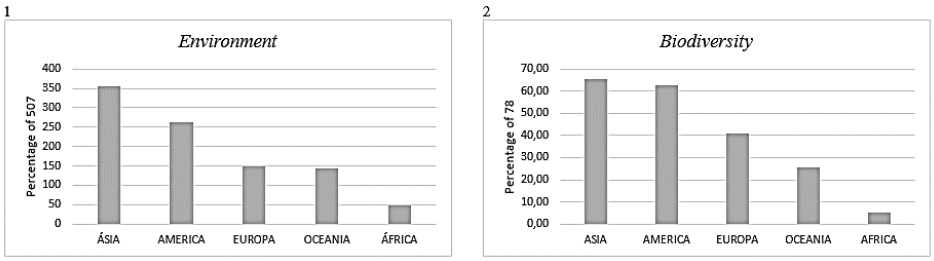

Figure 2 Distribution of paper related to mangroves, in each continent for the world research corpous. 1 – *Environment* e 2 – *Biodiversity*.

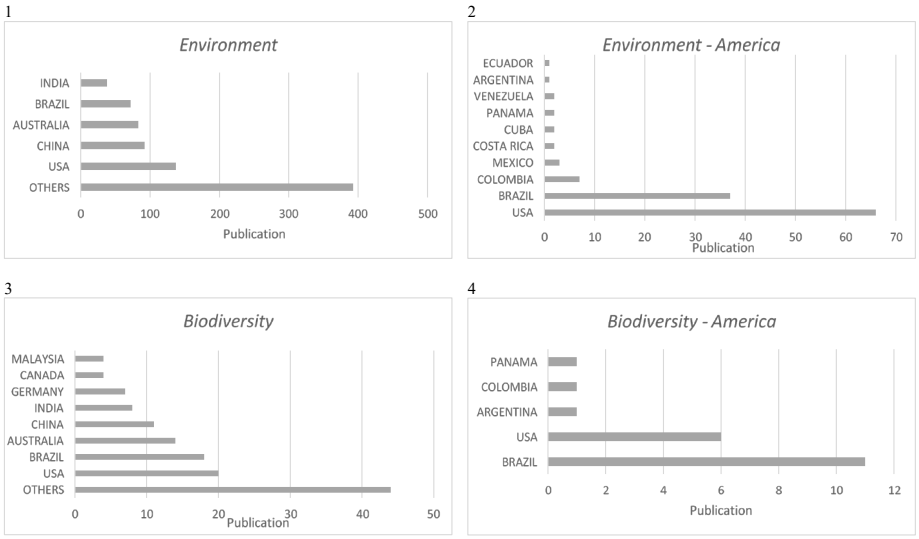

Figure 3 Countries contribuition (>5%) to scientific production to each studied corpus. 1 – *Environment;* 2 - *Environment-America*; 3 – *Biodiversity* e 4 – *Biodiversity-America*.

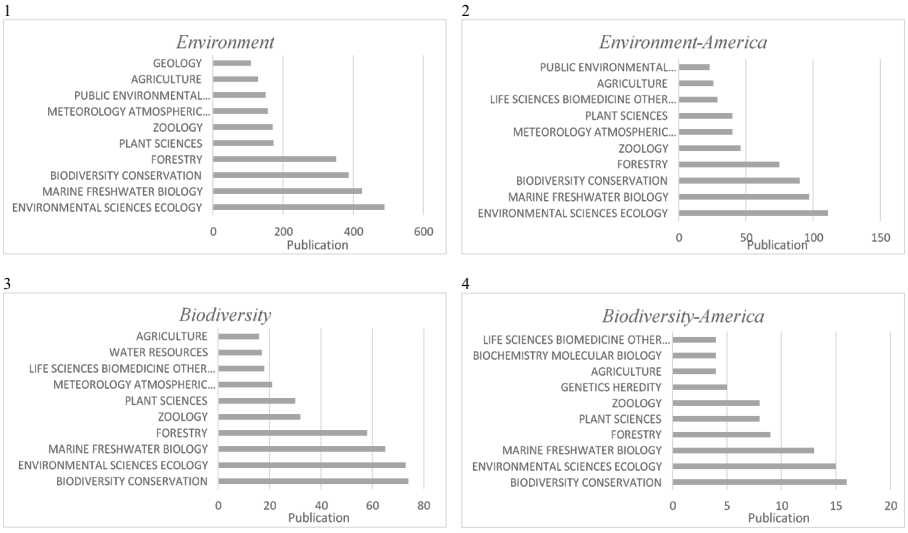

Figure 4 The ten most important research concentration area to each corpus studied. 1 – *Environment;* 2 - *Environment-America*; 3 – *Biodiversity* e 4 – *Biodiversity-America*.

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Regarding the studies' concentration areas, although in a different order of occurrence when restricted to Biodiversity, we still observe similarity. We can relate such homogeneity to the fact that the most prominent global scientific producer is the United States and the southeastern region of Brazil, one of the isolated regions that presents the greatest scientific growth between the 1980s and 2010.[21] In this way, we can understand how the two countries that most collaborate for global scientific production on mangroves are in America; there is a logical trend towards thematic and temporal homogeneity.

We could also see that the Web OF Science is an interesting and efficient database for this type of primary data collection, considering its internationality and selectivity regarding the quality of the journals addressed. However, it still presents a specific limitation when it does not cover local journals, which may underestimate the scientific production of specific locations.

Thus, it is possible to say that, based on a superficial scient metric analysis, scientific production on mangroves, mainly on Biodiversity and environmental effects and impacts, around the World is homogeneous in terms of frequency and period of publication, areas of study, and diversity notable of journals where they are published. However, as verified by Bordignon[22] an in-depth reading analysis would still be feasible for better classification and framing of these documents, for a more accurate interpretation and classification, and avoiding a possible bias on the results. Like an analysis based on experts in bibliometric analysis, based on a professional analysis of such metadata.[23-32]

CorText

The CorText platform extracted the vehicles for publishing articles and build the lists presented. When the list of journals where the articles referring to "*Environment"* were published, a total of 192 journals, of which 119(62%) represent only one article. For the "*Environment-America,"* we obtained a total of 69 journals, of which 45(65.2%) presented only 1 article. For the "*Biodiversity"* 60 journals, where 78.3% has only one published article. Finally, for the "*Biodiversity-America" data set*, 15 journals in which the only one presented two different publications.

In total, we recorded publications in 192 different journals. However, in 87 of them, there was only one article from a single data set. We chose to present in Table 1 the 20 journals that presented the 20 largest concentrations of publications to facilitate and optimize the interpretation. With this survey, we could observe a specific heterogeneity regarding the vehicle for publishing scientific productions. We can notice the 20 most frequent magazines, showing a wide variety of good scientific journals available.

Table 1 List of magazines with the most significant number of publications for the four data sets: E - Environment, E-A - Environment-America, B - Biodiversity and B-A - Biodiversity-America

Journal	E	E-A	B	B-A
Estuarine coastal and shelf science	30	6	1	
Marine pollution bulletin	30	3	2	
Science of the total environment	18	3	2	1
Hydrobiologia	14	4	1	
Marine ecology progress series	13	2	3	
Plos One	12	2	4	

Table Continued...

Journal	E	E-A	B	B-A
Journal of experimental marine biology and ecology	13	2	2	
Journal of coastal research	11	5	1	
Environmental monitoring and assessment	13		1	1
Wetlands	9	4	1	
Wetlands ecology and management	8	3	3	
Environmental pollution	12	1		
Ecotoxicology and environmental safety	7	2	1	1
Forest ecology and management	7	1	2	
Bulletin of marine science	5	5		
Chemosphere	8		1	
Global change biology	7	2		
Oecologia	5	4		
Ecological engineering	5	1	1	1
Ecosphere	3	2	2	1

Conclusion

At the beginning of this project, we raised whether to standardize global scientific production regarding mangroves, with an environmental focus, impacts, effects, and Biodiversity. This question arose when we observed the growing global production on the subject in recent years.

We were able to observe, then, a homogeneous relationship when comparing all the research corpus obtained. This relationship answers the study's central question, showing us that there is a sure standardization of the quality and areas of concentration of this type of research globally. It also opens the possibility for future studies to combine global knowledge about mangroves and to optimize the efforts that have been applied by scientists all over the World to develop standard mangrove preservation, conservation, and restoration policies.

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Conflicts of interest

The authors have no conflict of interest.

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