Scientific mapping of the knowledge on the El Cielo Biosphere Reserve

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ABSTRACT

The current knowledge of the El Cielo Biosphere Reserve (CBR), Tamaulipas, Mexico was identified from scientific publications between 1993 and 2019.

Objective: Analyze, synthesize and categorize the published research on the El Cielo Biosphere Reserve (CBR), Tamaulipas.

Design/methodology/approach: The methodology focused on searching, classifying and reviewing existing sources in the SCOPUS database from a knowledge base perspective. The assessment recovered 37 publications that were analyzed and mapped in four dimensions: size, time, space, and composition. The analyzes were performed using the Bibliometrix and Biblioshiny software tools.

Results: The reviewed publications addressed biodiversity studies from a disciplinary approach and from an ecological perspective, which produces a fragmented knowledge of this territory and its problems.

Limitations on study/implications: There may be publications not appearing in the Scopus database.

Findings/conclusions: The knowledge of the El Cielo Biosphere Reserve is fragmented, with a disciplinary approach and from an ecological perspective. The lack of a critical mass of researchers to generate useful knowledge is observed. A weak intellectual structure is also found, which generates a reduced contribution to the conservation of biodiversity. The original contribution of this paper is the synthesis of the current state of the knowledge regard biodiversity and conservation of the El Cielo Biosphere Reserve, which had not been performed previously.

Keywords: Science Mapping, Knowledge basis, Knowledge management, El Cielo Biosphere Reserve.

INTRODUCTION

The effective conservation of biodiversity is based on knowledge and understanding of ecological patterns and processes (Fischer & Lindenmayer, 2007; Fahrig *et al.*, 2011; Tscharntke *et al.*, 2012). However, research such as that from Giehl *et al.* (2017) documents there is no reliable information on the available scientific knowledge, or if this is used to design conservation processes. Hallinger & Suriyankietkaew (2018) point out that the analysis of the knowledge basis can be done in four dimensions: size, time, space and composition. Size is the volume of accumulated knowledge. The productive knowledge

accumulation requires a critical mass of research and a long time must pass before a discipline or field accumulates a sufficient body of knowledge. Therefore, knowledge size is necessary but an insufficient precondition for a useful knowledge base (Hallinger & Suriyankietkaew, 2018). In this context, according to Richardson (2013), the accumulation of knowledge is a dynamic process that changes over time. Time refers to the paths that a publication follows within a discipline or research line. Meanwhile, space refers to the geographical distribution of documents within a knowledge base. The spatial distribution offers information on academic ability and reveals concentrations and gaps in the production and knowledge accumulation in different societies (Hallinger & Suriyankietkaew, 2018).

The composition of the intellectual structure of the knowledge basis is the fourth dimension. It allows identifying gaps, orientations, structures and patterns of the research, thus exposing how the study of a territory and the development of knowledge are approached (Topp & Loos, 2019). In this regard, Gazni *et al.* (2012), Khasseh *et al.* (2017), Wagner *et al.* (2017), and López & Sassone (2019) point out that the studies are carried out at a country level and it is necessary to be complemented with what happens in each protected natural areas (PNA), given that these represent specific situations that must be addressed to ensure their conservation. In this sense, it should be noted that no previous studies were found in a PNA in Tamaulipas, Mexico.

The central axis of this research was to analyze, synthesize and categorize the published research from the El Cielo Biosphere Reserve (CBR), Tamaulipas, Mexico. Two characteristics distinguish this review: it is a first on the produced knowledge, and second, its "scientific mapping" used (Zupic & Čater, 2015), a research review method designed to synthesize patterns on the knowledge production within a discipline, rather than synthesizing substantive findings.

For this, four research questions were posed: 1) What is the size, growth trajectory and distribution of the literature on CBR?, 2) What are the topics studied by academics in the CBR area?, 3) What journals have been used by the authors to disseminate their findings?, and 4) What is the intellectual structure of the CBR knowledge base?

In this research structure, in the first place are the antecedents that include aspects of relevant knowledge generation for this research and the previously reported work in the literature. Subsequently, the methodology used for this study is described. Then the obtained results and their discussion are presented. Finally, the main conclusions of the research and future works established that follow up on the research topic are presented.

MATERIALS AND METHODS

To analyze the scientific production on the CBR, the research results described in scientific papers, book chapters and reviews were assessed. A retrospective quantitative analysis was performed based on the articles published in the Scopus database (https://www.scopus.com). For its identification, the combination of the words "Reserva Biosfera El Cielo Tamaulipas México - Biosphere Reserve El Cielo Tamaulipas Mexico" was used. The search took place on March 18, 2019. The search date range of the publications was open. The initial documents selection eliminated ineligible source types (research that cited work done in the CBR or only mentioned it as a context) and duplicate elements.

First, the searches were done for all fields, later, it was carried out by article title, abstract and keywords, to ensure that the articles belonged to the CBR, leaving 37 articles. The first was published in 1993, so the investigation period comprises from 1993 to March 2019, that is, 26 years. For the analysis of these 37 papers, the associated bibliometric data was downloaded from Scopus in BIBX format, the extracted metadata included the authors' names, affiliation information, year of publication, keywords, abstracts, and various citations information. Later, analyzed with the Bibliometrix package through the Biblioshiny application, both implemented in the R statistical software environment (R CoreTeam, 2016).

Descriptive techniques were used to determine the size, growth trajectory and geographic distribution of the publications and to document the main characteristics of the knowledge base on the CBR. Regarding the bibliometric analysis, a citation analysis was applied to evaluate the impact and influence of the authors and documents. The citation analysis examines the direct impact of the documents included in the review database by calculating the number of times each document or author has been cited by other documents located in the Scopus index. Lotka's law (Lotka, 1926; Urbizagastegui, 1999) was used to group authors according to their productivity. While identifying the core publications, Bradford's law (East, 1983; Alvarado, 2016) was used to identify both cases, the most productive researchers and the most relevant journals in this field of study.

RESULTS AND DISCUSSION
The results were organized around the four research questions laid at the beginning of the research.

Size, growth path, and distribution of the literature on the CBR
The knowledge database is made up of 37 publications, published between 1993 and 2019 and represents a reduced set of knowledge, not generated in a systematic manner.
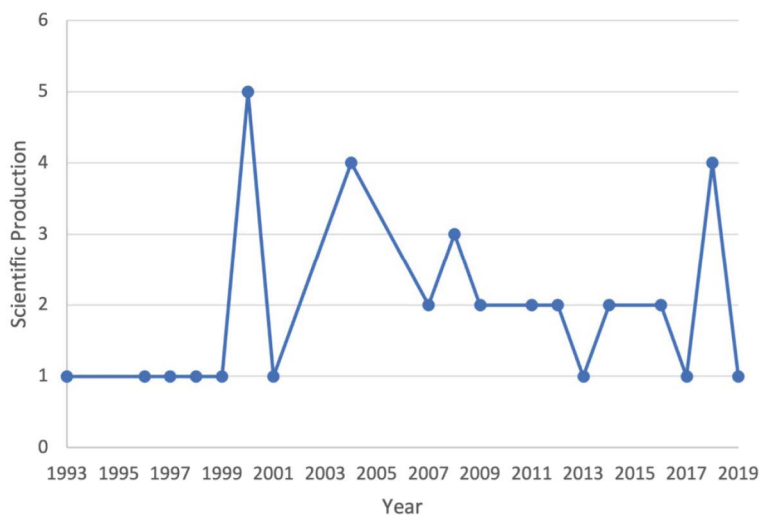
Figure 1. Distribution of the existing literature on the El Cielo Biosphere Reserve between 1993 and 2019.

The main type of published document was as scientific articles and constitutes 94.59% of the production. The remaining 5.41% was made up of a book chapter and a review.

Topics studied by academics in the area of CBR

The most researched topic was its plant community. Twenty publications were identified, followed by 12 on their animals. There is one on mushrooms and four addressing cross-cutting issues. Figure 2 shows the topics addressed overtime in the analyzed publications.
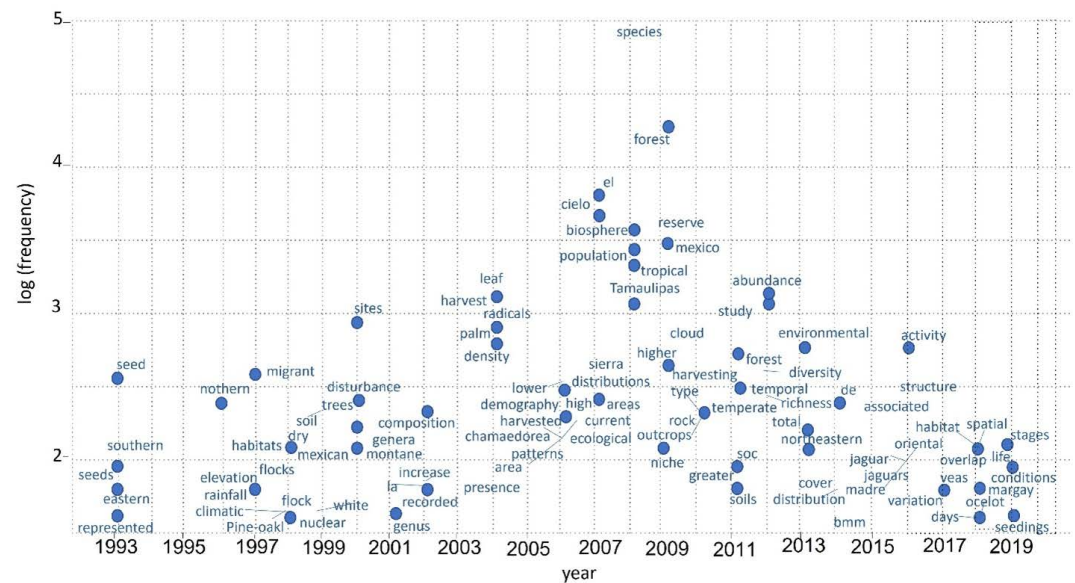

Figure 2. Evolution of the investigated topics on the CBR between 1993 and 2019.

Analysis of influential journals, authors and documents

This research question inquired about the composition of the knowledge database from the perspective of their sources, academics, and documents. The assessed papers were found to be published in 28 journals. The impact of the chosen journals on which the research results on the CBR were published was determined based on the *h*-index, which defines the quality based on the number of citations a scientific article receives (Hirsch, 2005), finding that the most important is Journal of Tropical Ecology of the USA (Figure 3).

The most cited source in the list of reference publications in Ecology with 79 citations, followed by Conservation Biology with 48. Both journals are published in the USA. With bibliometric analysis, key scholars and documents within a research field can be identified. In this sense, based on Bradford's law, five core journals were identified, the most relevant being: the *Journal of Tropical Ecology* from England, *Southwestern Naturalist and Condor* from USA, the *Revista de Biología Tropical* from Costa Rica, and the *Revista de Geofísica* from Mexico.
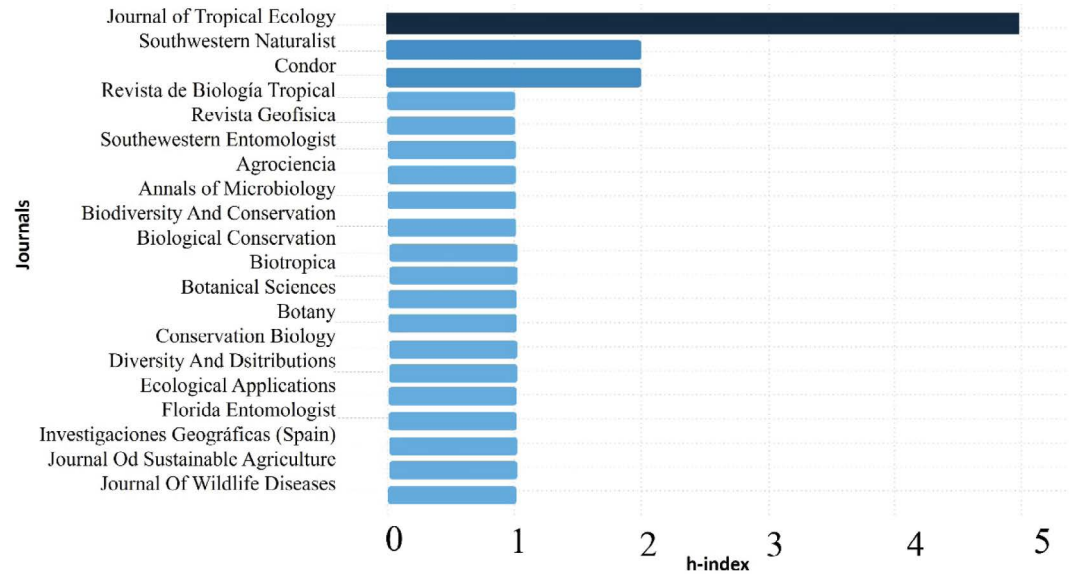
Figure 3. Impact of the journals (*h*-index) chosen to publish research on the CBR between 1993 and 2019.

In the 37 publications on the CBR from 1993 to 2019, 90 authors participated (Figure 4), the most important authors with their publications and citations, where the size of the circles is proportional to the number of documents published in that year, while the color intensity relates to the total of citations per year.

As can be seen, Gorchov DL is the researcher with the highest production (eight articles) and the highest number of citations, followed by Edress B. (five), both from the USA. The Miami University of Ohio State in the USA is the institution from which the largest number of publications were produced. The total number of citations in the analyzed documents was 599. Their highest number was 248 and reported during 2004.
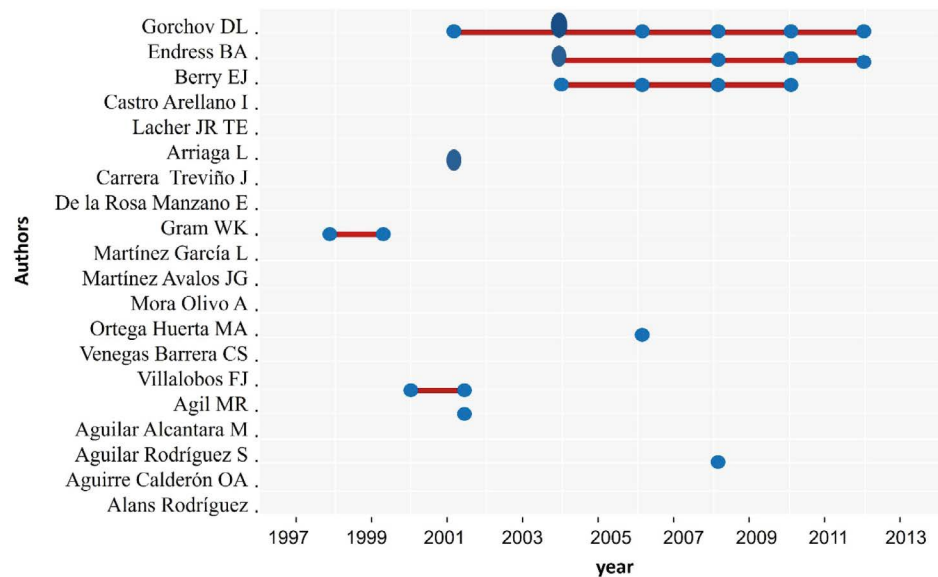
Figure 4. Most relevant authors with their publications and citations.

The analysis of the most relevant documents, presented in Table 1, referring to the most globally cited documents. The data presented should be interpreted in light of two considerations: most of the most cited researchers publishing on the CBR have a low actual level of Scopus citations, and none is identified as leading worldwide. These findings, therefore, reaffirm that the knowledge base is incipient.

Table 1. Documents most cited worldwide.

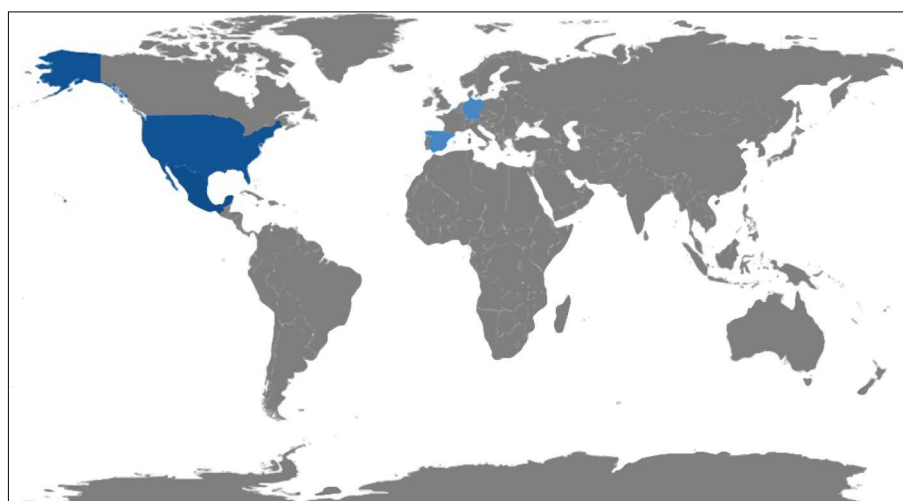| Source	Total cited	Total cited per year
Ortega-Huerta MA, 2004, Diversity Distrib	103	6.0588
Rojas-Soto OR, 2012, Biodiversity Conserv	62	6.8889
Endress BA, 2004, Ecol Appl	62	3.6471
Endress BA, 2004, Conserv Biol	58	3.4118
Gram WK, 1997, Condor	32	1.3333
Gram WK, 1998, Condor	32	1.3913
Berry EJ, 2004, J Trop Ecol	25	1.4706
Arriaga L, 2000, J Trop Ecol-a	25	1.1905
Berry EJ, 2008, Popul Ecol	21	1.6154
Castro-Arellano I, 2009, J Trop Ecol	20	1.6667
Castro-Arellano I, 2008, J Wildl Manage	19	1.4615
Arriaga L, 2000, J Trop Ecol	18	0.8571
Williams-Linera G, 1993, J Trop Ecol	17	0.6071
Castro-Arellano I, 2009, J Wildl Dis	13	1.0833
Berry EJ, 2007, Biotropica	11	0.7857
Ortega Huerta MA, 2007, Biol Conserv	11	0.7857
Jones FA, 2000, Southwest Nat	11	0.5238
Jones RW, 2012, Rev Mex Biodiversidad	7	0.7778
Cruz-Flores G, 2011, Agrociencia	6	0.6
Ramos-Garza J, 2016, Ann Microbiol	5	1

Intellectual structure of the CBR knowledge base

An approach that has been used in scientific mapping was applied on the author and co-citation analysis (ACA). Table 2, on the summary of countries with several publications with national and foreign authors, includes the number of publications with at least one foreign author (*MCP=Multiple Country Publication*) as well as the number of publications that have national authors (*SCP=Single Country Publication*). The value of the MCP rate is a measure of the intensity of the international collaboration of each country. It can be seen that researchers mainly collaborate with institutions in their own countries.

The geographical distribution of the scientific production by country is presented in Figure 5, where it is observed that Mexico and the USA are the countries that publish the most on the CBR. In the map colors, a strong intensity indicates a lot of academic production while a light intensity represents little. In this sense, Mexico registered 48 coauthors, the USA 35, and Germany and Spain one. The citations contained in the

articles are concentrated in three countries: USA with 308 citations, Mexico with 208 and Antigua with 65.

Table 2. Summary of countries with the number of publications with national and foreign authors.

Country	Number of publications	Publications with national authors (*SCP=Single Country Publications*)	Publications with at least one foreign author (*MCP=Multiple Country Publications*)	Value MCP
México	17	14	3	0.176
EUA	13	10	3	0.231
Antigua	2	2	0	0.000
Total	32	26	6	

Figure 5. Scientific production by country.

In the Sankey diagram (http://sankey-diagram-generator.acquireprocure.com) shown in Figure 6, the association between authors is emphasized, citations of their works, and keywords. This allows to visually relate the intellectual roots represented by the authors, the citations that they use in their works and the content of the research, represented by the keywords.

CONCLUSIONS

This review revealed that the generated literature is mainly descriptive and qualitative. Advancing the knowledge base on the CBR will require a broader set of research methodologies, capable of documenting and proposing different strategies for conservation, development and social inclusion of its inhabitants. Successful shift towards sustainability in organizations and societies requires leadership to provide a vision, as well as establish direction and motivate people to move towards new goals. Therefore, sustainable leadership is emerging as a new domain of study within the field of management (Hallinger, 2020). Finally, the various findings in this research suggest that the research on the CBR should be encouraged, in addition to carrying out transdisciplinary research based on the expert

knowledge of researchers who address the study of natural resources. Identifying major themes, trends, leaders, and core publications form the basis for identifying research gaps.
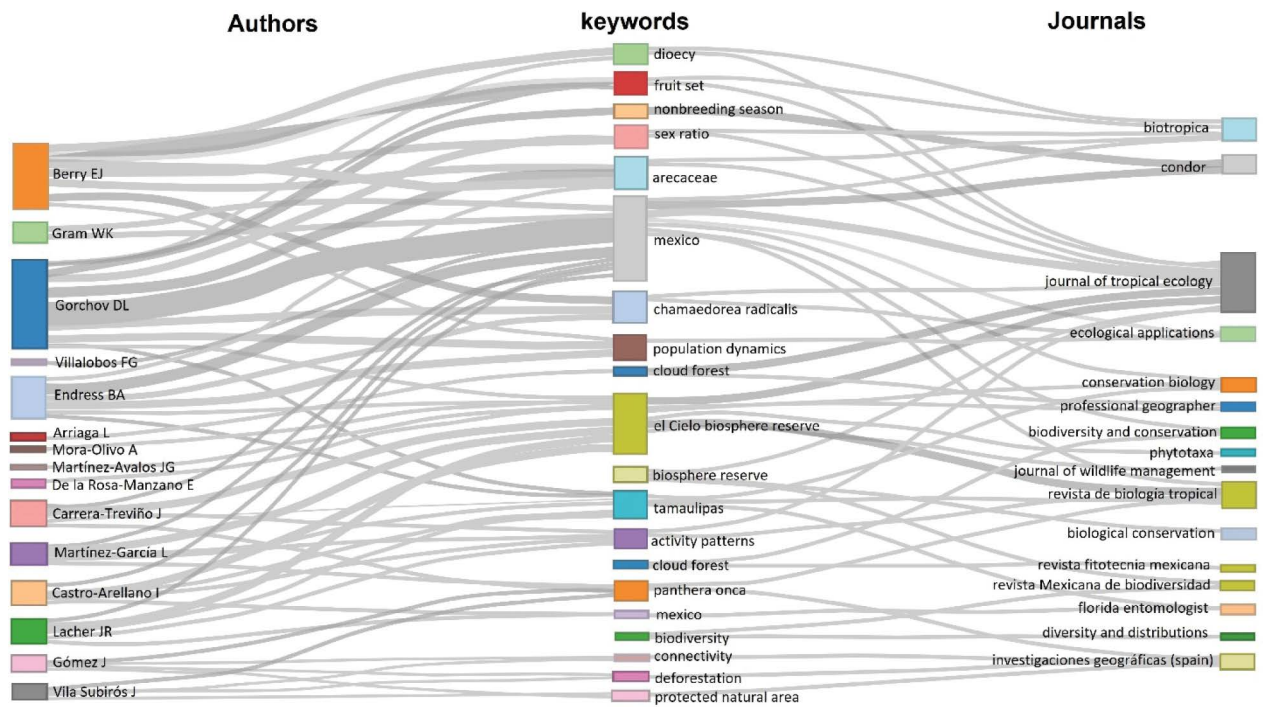
Figure 6. Intellectual roots and content of the research on the CBR.

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