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An Evaluation of Beach Management through Bibliometric Techniques

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Abstract*—Several bibliometric tools are being used to complement the literature review with application in the field of research, allowing to relate authors, works, research institutions, countries, among other topics. However, there was a lack of publications on beach management, governance, beach indicators and sustainability indicators. The aim of this work, within a descriptive and bibliographic approach, is to present through a bibliometric study using the VOSviewer tool, in Scopus Database, which authors are working on these topics, the most relevant journals, which universities are studying this subject and which countries have published the most in relation to the proposed theme. Despite the limitations related to bibliographic methods, the VOSviewer tool allowed us to present the evolution over time of which authors are publishing together with different disciplinarities, the most relevant publications, the degree of relationship between authors and between topics and journals.*

***Keywords*— beach management; governance; sustainability; indicators; VOSviewer.**

I. INTRODUCTION

Bibliometry, over the past decades, is presented as a measure of academic performance in the construction of maps made from bibliographical data, having application in the field of research, with these different types of maps, showing the relationship between authors, documents, journals and keywords. (Van Eck et al. [11])

In this way, bibliometrics, through algorithms, searches for existing relationships by identifying the similarities between authors, documents, and keywords, using techniques such as citation, co-citation, biliographic coupling, coauthor and co-word, among the main ones.

Therefore, bibliometric methods allow to relate works, authors, institutions, countries, keywords, according to some metrics. They map these units of analysis according to the intensity of the proposed metric and project their results from this information.

There are few works on bibliometrics that have been done about beach management. Botero and Hurtado [1] carried out a bibliometrics analysis based on Science Direct and SciELO databases using the keyword "Beach Management" and the keywords "Beach" and "Classification" together, considering a time window from the year 2000. They have resulted in 21 occurrences, being 14 and 7 respectively the results of evidence related to the searches with the mentioned keywords. Of these 21 works, 19% cover geomorphology, 19% marine biology and 19 tourist beaches. They noted that few authors wrote about beach types and some of them mixed the classification.

In another bibliometric research, Botero et al. [2] evaluated environmental quality in tourist beaches, in a time window from 1997 to 2011, which resulted in 40 documents. Therefore, there was a lack of publications on beach management, governance, beach indicators and sustainability indicators.

The motivation and justification found for this work comes from the search for knowledge inherent to the theme of coastal management, through bibliometrics, specifically in matters related to beach management, governance, beach indicators and sustainability indicators, given the shortage of publications involving all these topics within the same context.

Thus, the objective of this work is to identify, through a bibliometric tool, which authors most influenced the research of the beach ecosystem considering the point of view of its management, its governance, its sustainability and its indicators.

In addition, this study, within a qualitative approach and a descriptive and bibliographical research, has the specific objectives of presenting which journals and disciplines have the most impact in this research area, who are the specialists in this area, what can be known about this area, the most influential works in the Scopus database, in which countries this theme is researched and which organizations are involved, which are the most influential authors and their degree of relationship with

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beach management, which authors are quoted together and what are their works and their latest research in this proposed theme.

The work is divided into four parts. The first, this introduction. The second part specifically addresses the methodology and the theoretical basis used. The third part presents the results and the discussion invoking a practical application of the VOSviewer tool in a bibliometric survey with the beach management subject. And finally, the conclusion of the research is presented showing the specific objectives met, the limitations of the use of this tool, besides the suggestion for future studies.

II. BIBLIOGRAPHIC REVIEW

Given the wide availability of articles in several databases and through the significant growth of academic content and search engines, the challenge for researchers shifts from the scarcity of information to the selection of the most pertinent and adequate articles in the construction of the argumentation of this work (ANDRADE & FARIAS FILHO [4])

In this context, bibliometry presents itself as a field of knowledge called scientometrics, according to evidences found in Boyack et al. [5] "mapping the backbone of Science".

Nonetheless, Scientometrics is a technology based on quotation, justified by the fact that when an author quotes another author the research provides information about the relationships between these authors, their ideas, the journals and the institutions involved in their research. Scientometrics grew in use after its application in the creation of the Science Citation Index (SCI), performed by Eugene Garfield in 1950, which helped not only the editors and databases in the evaluation of their research, but also the researchers in the search for the best literature sought. (MINGERS & LEYDESDORFF [6])

Yoshida [7] reports that bibliometrics is usually related to the counting of publications or quotations found in scientific and academic publications, and does not necessarily elaborate a content analysis, although it can apply the tracking of all the content of the publications. In this case, the algorithm that supports the bibliometric method searches for patterns or explanations for unstructured behaviors and makes a wider sweep to quantify the number of occurrences of the terms within the texts and eventually calculates the semantic distance between them.

In the literature there are two approaches presented by researchers of this subject. The approach focused on bibliographic methods, explored by Zupic & Cater [8] and the approach that shows bibliometrics as a process, that is, developed to map the progress of knowledge in a field, explored by Cobo et al. [9].

The method proposed by Zupic & Cater [8] uses bibliometrics to examine how disciplines, fields, subjects and articles are related to one another by means of a spatial representation consisting of geographical maps and analogies found. The goal is to create a representation of the research structure by partitioning the elements (documents, authors, articles, words) into different groups.

Bibliometric methods use a systematic, transparent and reproducible review that uses a quantitative approach to the description, evaluation and monitoring of the published research, avoiding the bias obtained when using qualitative methods supported by a bibliographic review and improving the quality of the bibliographic review. (Zupic & Cater [8])

Wilsdon et al. [10] report that the quality and impact on research have been attributed by peer review and a variety of quantitative indicators. Peer review has been more widely used, but over the last 20 years the use of metrics has emerged as a potential approach.

Zupic & Cater [8] point out that bibliometric methods allow researchers to find their results from aggregated data provided by other researchers using citation, co-citation and primary data, and from this, emit their opinion contemplating, in their analyzes, structured fields, social networks and focal interests.

Yoshida [7] mention that choosing the database is a limitation of the search. In the work of this author he mentions that the content of the Scopus and Web of Science (WoS) bases generate very similar results, with high correlation (R2 approximately 0.99), a fact that is scientifically proven. This fact helps to confirm the choice of using the Scopus database for research in this work.

Zupic and Cater [8] believe that bibliometric methods do not replace but rather complement traditional methods of reviewing structured literature and meta-analysis.

Notwithstanding, Van Eck et al. [11], in the comparison between two techniques of bibliometric mapping, Multidimensional Scaling (MDS) and VOS, concluded, from three experimental datasets involving co-citations and co-occurrence of keywords, that, in general, maps constructed using the VOS technique provide a better representation of the data than those constructed with MDS. However, it is not the scope of this paper to present the theoretical mathematical discussion about these techniques referenced by these authors.

Based on this, it was sought, in this research, to use the technique of VOS and it was verified that this technique can be implemented through the tool VOSviewer available free in the VOSviewer site [12] in Internet, by Van Eck & Waltman, their authors. At the time of this research, this tool was in version 1.6.4, version available

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on April 7, 2016, at www.vosviewer.com. This version includes citation search, co-occurrence of words, support for Web of Science, Scopus and PubMed database files, as well as support for RIS files available in the Mendeley, BibSonomy, Zotero and Perish databases.

According to information available on the product website, the software also allows automatic adjustment and approximation of the values of the parameters presented on the screen, besides having a friendlier interface than previous versions. It is feasible to import and export Pajek and GML files, besides allowing the use of clustering techniques and network layout techniques. (VOSviewer [12])

VOSviewer has the ability in create keyword co-occurrence maps based on a set of documents. This map determines the distance between words, which indicates the level of relationship between them. The smaller the distance between two terms, the greater the relation between them (Van Eck &Waltman 2014).

2.1 Methodology

The methodology has a quantitative approach and shows how a bibliometric analysis, carried out through an appropriate tool, could contribute to the literature review focusing on a scientific research in the field of beach management.

The work was carried out with data collection in the Scopus database, in peer reviewed journals, addressing the topics beach management, governance, sustainability and indicators. The research was done with temporal limitation for the last 5 years, which pointed out 104 documents as a result.

The choice of the Scopus database is justified by the fact that it covers a referential source of peer-reviewed journals, using more than 46 million records, with approximately 22,000 content titles from more than 5,000 publishers, on fields involving areas of science, technology, social sciences, among others (SCOPUS, [3]).

Regarding the method, this research is divided into two parts. The first is performed on the Scopus website and the second on the user's machine. On the Scopus website, a tree was created composed of the four keywords of the research (beaches management, governance, beach indicators and sustainability indicators) linked by "AND" type Boolean connectors. As a result, only 3 documents were returned, all linked to surfing. In this way, the opposite situation with all the Boolean connectors set to type "OR" was used, considering the absence of temporal limitation, which returned as a result 104 documents.

Therefore, it was chosen on the last research to use open connectors, making only one adjustment of peer-reviewed literature. In this way, after adjustment of the time window for the last 5 years from 2012 until the date of July 20, 2016 and the withdrawal of repeated documents, a file with 48 documents was generated by the Scopus database. It was exported as a csv file to a directory created on the researcher's own machine.

In the second part, the software VOSviewer version 1.6.4.0 was installed on a computer with the following configuration: Intel i7 processor, 8GB memory, 500 GB hard disk, running under Windows 8.1 operating system. After installing VOSviewer, the software was initialized and pointed to the file previously imported with the csv extension, indicating the type of analysis desired for the search.

III. RESULTS AND DISCUSSION

Following the systematics suggested by Zupic and Cater [8], from the research question a keyword tree was created that meets the research criteria. To do this, the following key was inserted in the subject field in the Scopus database: beaches management OR beaches governance OR sustainability indicators. This resulted in 104 documents contained in a time window from 2012 until July 20, 2016.

Then the VOSviewer tool was installed, generating a map based on bibliographic data that can be visualized in fig. 1. To do this, the file with csv extension generated and exported by the Scopus database was selected. This file was previously extracted in the query with 104 documents returned and defined by the previously established keywords in the time window corresponding to the last 5 years.

In selecting the parameters to work with the VOSviewer tool, one must first choose the bibliometric method that will be used, according to the research question that is to be answered, as reported above. Applying the methodology with the tool VOSviewer, for the type of co-citation analysis, the "references cited" analysis unit and the "total count" method were chosen in the software. In the next screen of the VOSviewer has to choose the tendency (reduction of network) by means of the minimum number of citations that meet this reference. By clicking on "Finish", the network visualization in the form of mapping can already be seen and still allows customization. The software allows to know the visualization by density showing the hot areas, and their references, with some of them containing the DOI of the document that allows its opening.

Fig. 1 and Fig.2 show the mapping created in density and network view, respectively. It shows the strength of the clusters through the density of the network, where the greatest connection strength represents a concentration in a measure of heat. The strongest evidence of the terms with the highest number of citations and the highest

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density of relations are represented by the colors that gradually intensify to the red color and group together. As a solution for questioning the most cited authors, the citation mapping was performed, evidencing the following authors: Ariza, Botero, Lucrezi, Cervantes, Botero, Martin and Sardá. Therefore, these are the authors who most influenced this research supported by the keyword tree created and are divided into two clusters.

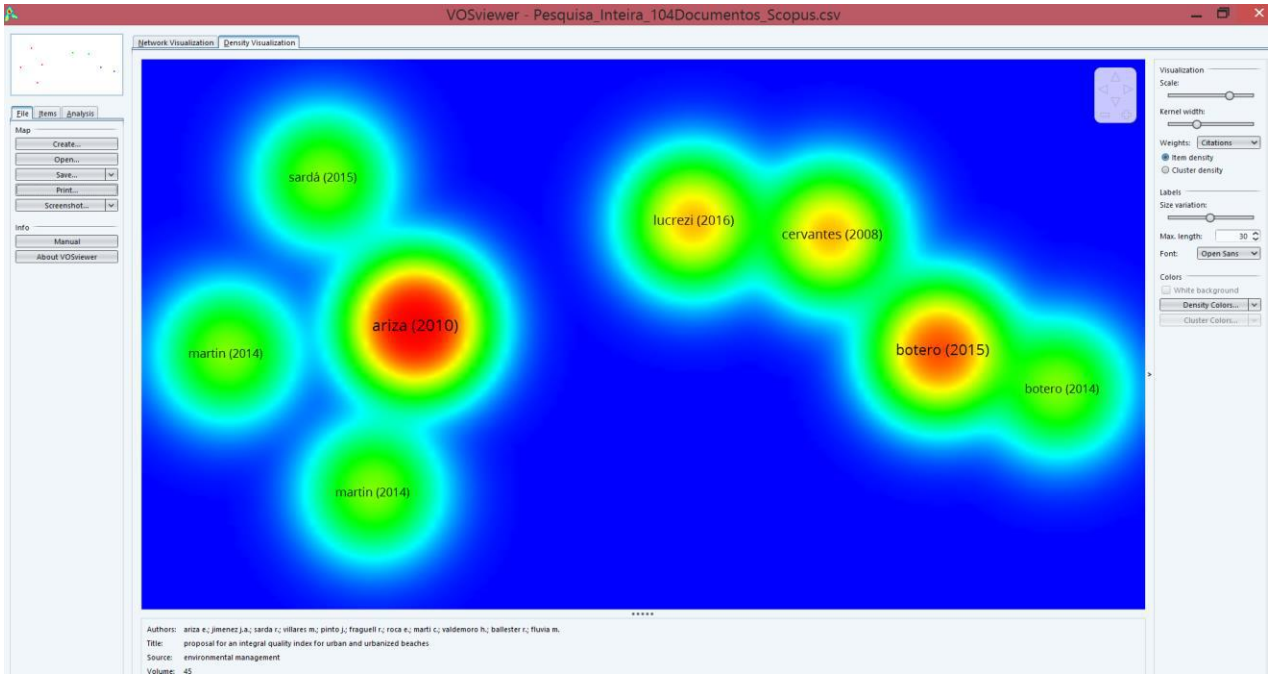

Fig. 1: Density Visualization (Source: Authors based in VOSviewer version 1.6.4)

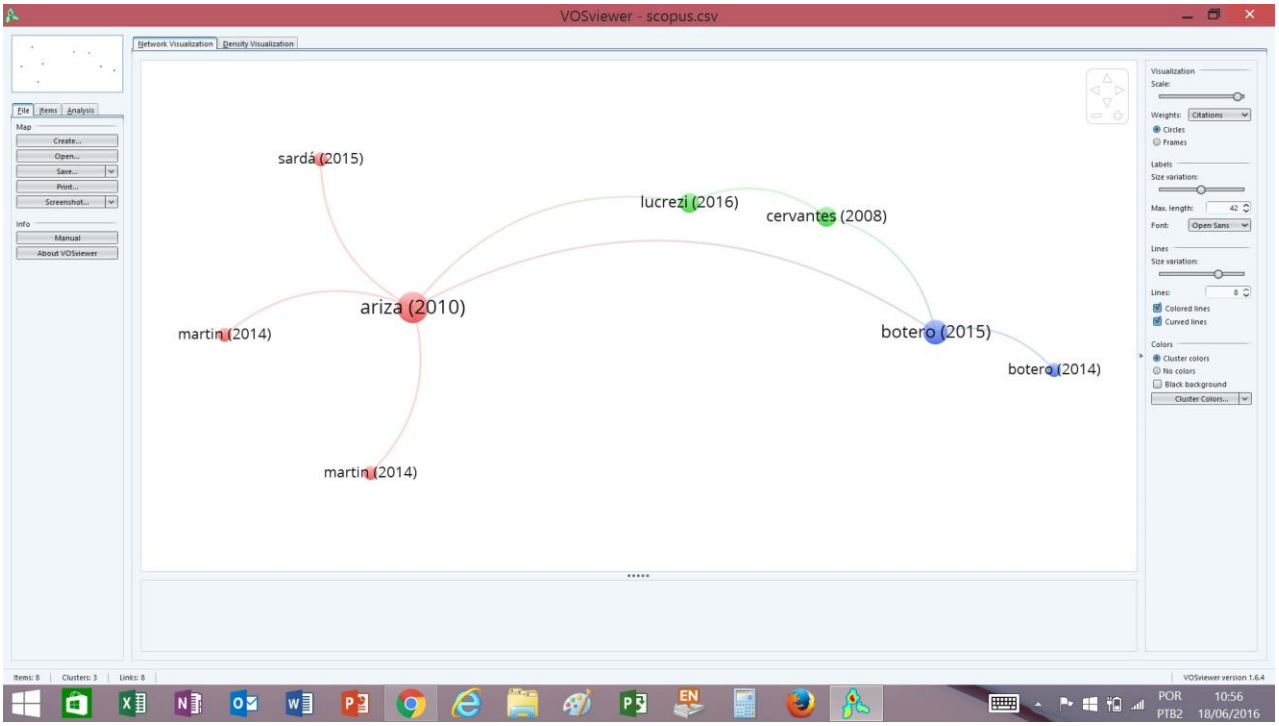

Fig. 2: Network Visualization (Source: Authors based in VOSviewer version 1.6.4)

In the same way, the software allows an adjustment for the type of analysis "source" and, adjusting the minimum of documents in the source in "3", presented the following results: Journal of Coastal Research (4); Environmental Monitoring and Assessment (4) and Estuarine, Coastal and Shelf Science (4), Ecological Indicators (3) and Natural Hazards (3).

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In the density visualization mode (fig.2), we can see the relationship between authors. Relevant conclusions from the observation of this mapping are:

a) the author Ariza and the author Botero present a higher density in the visualization and these authors are related through the authors Lucrezi and Cervantes.

b) the author Ariza stands out in the field of indicators for beach management, Botero in the field of Environmental Monitoring of Beaches, Cervantes in the Integrated Coastal Assessment and Lucrezi in the evaluation of sustainability indicators in beaches.

c) as an essential reading recommendation for the beach management is suggested the work "Proposal for an Integral Quality Index for Urban and Urbanized Beaches", by Eduard Ariza et al. (2010), available in the journal Environmental Management, v.45, n.5, p.998-1013. This indication is given by the number assigned to the force of the largest link that originates from the author Ariza.

Also in relation to the citation mapping, in choosing the type of analysis and counting method in VOSviewer, it is possible to select the type of analysis "citation", the analysis unit "organizations" and, selecting the minimum number of documents published by a organization as "2", the results presented were as follows: East China Sea Center of Environment Monitoring in Shanghai, China; Key Laboratory of Marine Integrated Monitoring and Applied Technologies of Harmful Algal Blooms in Shanghai, China and Prince of Songkla University in Phuket, Thailand.

Likewise, in citation mapping it is possible to select the type of analysis "citation" with the unit of analysis "countries" and, by adjusting the minimum number of documents published by country as "5", the following result was obtained: United States (13); Brazil (10); Spain (8); China (7); Italy (7); Portugal (7); United Kingdom (5); France (5); India (5) and Mexico (5).

In the mapping strategy based on co-authorship, after configuring VOSviewer to group clusters for authors with at least three shared documents, it was observed that of the 389 authors, only 2 authors have at least 3 co-authorship works: Martin and Assenov.

The co-authorship mapping, considering the same keyword tree, showed another cluster with the author Erzini, however this cluster pointed out that this author has 3 works, but all without co-authorship.

In the view by Bibliographic Coupling, VOSviewer identified, from the total of documents surveyed, that less than half were related to this technique. The main authors that used this technique were: Martin, Botero, Lucrezi, Sardá, Alexandrakis, Di Paola, González and Cardoso.

In relation to the networks of relationship using the technique of Bibliographic Coupling, it is verified:

a) a strong relationship between Cervantes and Lucrezi (strength grade 9), Gonzalez and Lucrezi (strength grade 8), Ariza e Lucrezi (strength grade 7), Cardoso e Lucrezi (strength grade 7), Botero and Lucrezi (degree of strength strength 6), Cardozo and Reyes-Martinez (strength level 5).

b) a medium relationship between Sardá and Ariza (degree of force 3), Sardá and Lucrezi (strength level 3), Ariza and Gonzalez (strength level 2) and Alexandrakis and Lucrezi (strength level 2).

c) a weak relationship for the other authors with degree of strength 1, being considered irrelevant.

Regarding the mapping using the co-citation technique, it was verified that of the 4438 references, considering a minimum of three citations for a given reference, Martin and Assenov were the authors that stood out the most.

In addition, it was noticed that all the network relationships between the authors are with a force factor 3, with no relation that stands out. In the mapping of visualization by density it is verified that all authors have the same density and no researchers are perceived as central or peripheral.

In the analysis of co-occurrence by words, the software used as a analysis unit all the keywords. Of the 1521 keywords analyzed, VOSviewer considered "5" the minimum number of occurrences for a given keyword, allowing the presentation of 48 keywords.

Regarding the strength of the relationship between the co-occurrences, it was verified that between the keywords "beaches" and "coastal zone" there is a force factor 10, between beaches and water pollution, the force factor is 5, between "beaches" and "environmental monitoring" is 5, between "bathing beaches" and "water quality" is 6, between "sediment" and "water pollution" is 5 and between "environmental monitoring" and "nonhuman" is 6 and between "nonhuman" and "water quality" is 7.

In the visualization of density co-occurrence mapping, we verified the following highlights with more than 100 occurrences: article (184), nonhuman (136), water pollution (134), beaches (131), water quality (116) and environmental monitoring (114).

In relation to the word-based mapping, the type of co-occurrence analysis and the "all words" analysis unit were configured in the VOSviewer. Then the minimum number of occurrences of a word was set to "6", which automatically converged the software to 32 words out of a total of 1521 keywords.

In the network visualization we verified some relations between keywords and their respective factors of strength: beaches and coastal zones (10); bathing beaches and environmental monitoring (6); environmental monitoring and water quality (8); beaches and

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vulnerability (4); coastal zones and erosion (3); beaches and erosion (3); seashore and sediment (5); water quality and bioindicator (4); water pollution and water quality (7); bathing beaches and nonhuman (6); nonhuman and water pollution (9); humans and nonhumans (4); sediment and water pollution (5); water analysand and nonhuman (6); beaches and environmental impact (4) and environmental impact and coastal zones (3).

In the mapping based on words, with density visualization, we observed hot areas in the following words with their occurrences: beaches (24), beach (12), seashore (10), article (23), nonhuman (13), (15), water quality (14), bathing beaches (8), sediment (7), seawater (9) and humans (6).

In relation to the first question about which authors most influence the research from the point of view of its management, its governance, its sustainability and its pertinent indicators, it is verified, after the analysis of the hot areas of fig. 1, that in the mapping based on citation, VOSviewer, analyzing its database containing a universe of 389 authors, the following authors are the ones that most influenced the research in the proposed theme: Ariza, Botero, Lucrezi and Cervantes. In addition, the author Ariza and the author Botero presented a higher density in the visualization in relation to the mapping by citation. Regarding co-authorship, of the 389 authors, it was verified that only 2 authors have at least 3 works in co-authorship: Martin and Assenov.

In relation to the publications that have more impact for this research, it is verified that the periodicals Estuarine, Coastal and Shelf Science and Journal of Coastal Research are more relevant containing 4 published documents and 1 citation each.

In relation to the most influential subjects in the research, the most cited and co-cited keywords in descending order of frequency were: beaches, article, water pollution, coastal zones, water quality, nonhuman, beach, bioindicator, environmental monitoring, seashore, vulnerability, seawater and bathing beaches.

Regarding the specialists in a research area, one can notice that the most influential works are related to the most cited authors, that is, Ariza, Botero, Lucrezi and Cervantes. From the authors, Ariza et al. present an essential reading recommendation for the management of beaches - Proposal for an Integral Quality Index for Urban and Urbanized Beaches, by authors Ariza et al. (2010), available in the journal Environmental Management, v.45, n.5, p.998-1013.

In relation to the technique of Bibliographic Coupling, we can see that there is a strong relationship between Cervantes and Lucrezi (strength level 9), Gonzalez and Lucrezi (strength level 8), Ariza and Lucrezi (strength level 7), Cardoso and Lucrezi (degree of strength 7), Botero and Lucrezi (strength level 6), Cardozo and Reyes-Martinez (strength level 5).

In relation to the co-citation, it was perceived as more relevant the relation between the authors Martin and Assenov. Another factor that deserves to be highlighted is that all the network relationships between the authors have a force factor 3, with no relationship that stands out. Still in relation to this method it was verified that the authors have the same density and no researcher is perceived as central nor as peripheral.

Regarding the co-occurrence research method, it was verified that the most relevant relationships with their respective degrees of strength are between the keywords "beaches" and "coastal zone" with a force factor of 10, between "nonhuman" and "water quality" with a force factor of 7 and between "bathing beaches" and "water quality" with a force factor of 6.

The relationship between beaches and coastal zone is evident as reported in the introduction and dispenses comments (force factor 10). The relationship between nonhuman factors and water quality reflects water pollution by other impacts not derived from human action and deserves to be investigated. Regarding the relationship between beaches for bathing and water quality, the contribution in relation to beach management is important and becomes evident.

In relation to the co-occurrence research method, the following keywords with more than 100 occurrences are verified in the density mapping: article (184), nonhuman (136), water pollution (134), beaches 131), water quality (116) and environmental monitoring (114). This suggests that the nonhuman scientific field, which is very relevant in this mapping, is investigated in the study of beach management.

In the mapping based on words configured with the type of analysis by co-occurrence, the main relationships between the 32 highlighted words that deserve attention are: beaches and coastal zones, with force factor 10; nonhuman and water pollution, with force factor 9; environmental monitoring and water quality, with force factor 8; water pollution and water quality, with force factor 7. Of these relationships the most surprising would be the relation nonhuman and water pollution, which relates water pollution by nonhuman factors that was already evidenced previously.

In the same type of word-based mapping, in a density analysis, the keywords water pollution, water quality, nonhuman and seashore are the ones that deserve greater prominence, besides the word beaches itself, in the management research of beaches.

Regarding organizations in which the subject of beach management under the governance, sustainability and

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performance indicators, the Universities of China in Shanghai are more involved in this field of research.

Finally, in relation to the geographic sites that are researching this subject, it is verified that the main countries are United States, Brazil and Spain.

IV. CONCLUSION

As mentioned above, due to the large number of publications available in the main databases, the selection of the most pertinent and appropriate articles on the construction of the theoretical research argument becomes the fundamental point.

For this, VOSviewer software, supported by algorithms that meet the citation, co-citation, biliographic coupling, co-author and co-word search methods, becomes a great option as it allows, with relative ease, the handling and extraction of information. The software presented a smooth installation and excellent performance, with no incompatibilities, well documented and available for use by the scientific community at no additional cost.

In relation to the objective of this work, the results of the last years, from 2010 to 2016, presented 138 authors and 26 journals, revealing the authors Ariza, Botero, Lucrezi and Cervantes as the ones that most influenced this research, being the first two with a higher density. From these experts the result pointed out that the work elaborated by Ariza et al. (2010), Proposal for an Integral Quality Index for Urban and Urbanized Beaches, is presented as an essential reading recommendation for the subject of beach management. In addition, the results of the research allowed pointing out the periodicals Estuarine, Coastal and Shelf Science and Journal of Coastal Research as the most relevant journals for the subject of this research.

Regarding the universities and the most active countries, the result showed that the Universities of China in Shanghai are more involved in the subject of this research, while the United States, Brazil and Spain were the countries that published the most to the proposed subject.

Regarding the disciplines that are pertinent to the subject of the research, it has been found that beaches, article, water pollution, coastal zones, water quality, nonhuman, beach, bioindicator, environmental monitoring, seashore, vulnerability, seawater and bathing beaches, are among the more relevant.

Of these disciplines, it was also verified that "beaches" and "coastal zone" have a strong connection with a force factor 10; "Nonhuman" and "water pollution" have a strong bond with a force factor 9; "Nonhuman" and "water quality" have a strong connection with a force factor 7 and "bathing beaches" and "water quality" have a median connection with a force factor 6. Of these relations it is important to emphasize the strong relation between the nonhuman factors and water quality and water pollution that merit future research.

However, in relation to density the most relevant disciplines are nonhuman (136), water pollution (134), beaches (131), water quality (116) and environmental monitoring (114).

Regarding the works produced in co-authorship, it was verified that the authors Martin and Assenov are the most relevant with 3 published works. The result showed that there is a strong relationship between Cervantes and Lucrezi; between Gonzalez and Lucrezi; between Ariza and Lucrezi and between Cardoso and Lucrezi. There is a moderate relationship between the authors Botero and Lucrezi and between Cardozo and Reyes-Martinez.

The results presented, as mentioned previously, should be understood as a complement to traditional methods of literature review and meta-analysis and not as a substitution of these.

This work has some limitations such as the method of bibliometry used (VOS), translated by a wider scan without performing a content analysis in the documents; and the research methods (citation, co-citation, biliographic coupling, coauthor and co-word), reported as weak points in Table 1; and the specific use of the Scopus database, since it does not involve subjects from all fields of science, and no longer provides subsidies for the intrinsic interdisciplinarity of the research theme. As future work, it is suggested that other studies with the same subject and keyword tree be applied in this database and in other databases and with other software for comparison of results.

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